CARAVAN OF LIGHT

K. K. MEHROTRA

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Selected and Edited by

K. K. MEHROTRA

M.A., B.Litt. (Oxon)

Lecturer in English, University of Allahabad

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Prefatory Note

THE selections which compose this volume have been chosen with a certain definite end in view. Many works of an inspirational nature are extant, but their interest and appeal are localized either to a particular country or to a continent. It will be found that this book contains not only such pieces as have a special appeal for the Indian youth, but several which transcend the barriers of age and race. The world is rapidly becoming small; 'narrow domestic walls' are crumbling; and a sane citizen of tomorrow will have to become a citizen of the world. This caravan travels over sea and air and land, through adventures brave and new, through heroic deeds and strange climes, with the beacon light of progress shining ever ahead.

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K. K. M.

Contents

I

Prisoners of the Dark

I

Let us just think for a moment how we have learnt everything we now know. How do we enjoy the company of our friends, and the beauties of the world around us? Surely it is by means of our eyes, our ears, and our tongues.

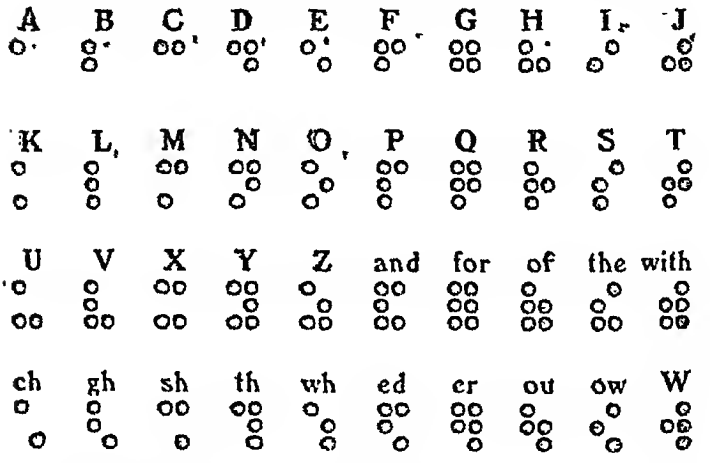
If we were blind we could see nothing of the beauty around us, but we could hear and talk to our friends, and be taught the meanings of things through our fingers and our ears. If we were deaf we could still see the wonderful world of nature, and learn by means of visible finger signs to talk, and to understand our friends.

But if we were both deaf and blind from babyhood how could any idea or any knowledge of the world creep into our minds? It would seem quite impossible to educate a child who could neither see nor hear nor speak.

Yet there are such children in the world, children who can have no idea of the world around them except what little they can gain by their senses of touch, taste, and smell. Their plight is pitiable indeed, and up to a hundred years ago it was absolutely hopeless.

One such poor little mite, Laura Bridgman, was taken one day to see Doctor Howe at an Institute for the blind in Boston, U.S.A.

Doctor Howe had spent much time in trying to educate blind children who could speak and hear, but now he took this little girl of eight whose mind was held prisoner not only behind the one wall of blindness, but behind



The Braille Alphabet—the black dots represent the little raised dots on the paper: blind persons feel these dots with the tips of their fingers, and so know what letter they are feeling; moving their finger from letter to letter, they spell out words, and so are able to read.

the triple wall of blindness, deafness, and dumbness; he determined to free her from her prison and to make her a happy and useful human being.

He first gave her things with which she was very familiar, such as a spoon and a fork. She felt these carefully and then on each was placed

a label bearing the raised letters s-p-o-o-n and f-o-r-k. She traced round these letters again and again, until the connexion between the word and the article dawned on her, and she was able to place the right label on each article.

This was repeated with other familiar articles, and then the letters were separated and she was taught to put them together again. In this way she learnt to 'see' with her fingers and to spell the names of many simple objects.

Laura Bridgman in later life

Then she was ready for finger spelling. A raised word was given to her, and her teacher made, in Laura's sensitive hand, the movements of the fingers which represent that word. The little girl practised making these movements until she could 'speak' with her fingers, and by putting her hand over the hands of her companion, could 'hear' with her fingers also.

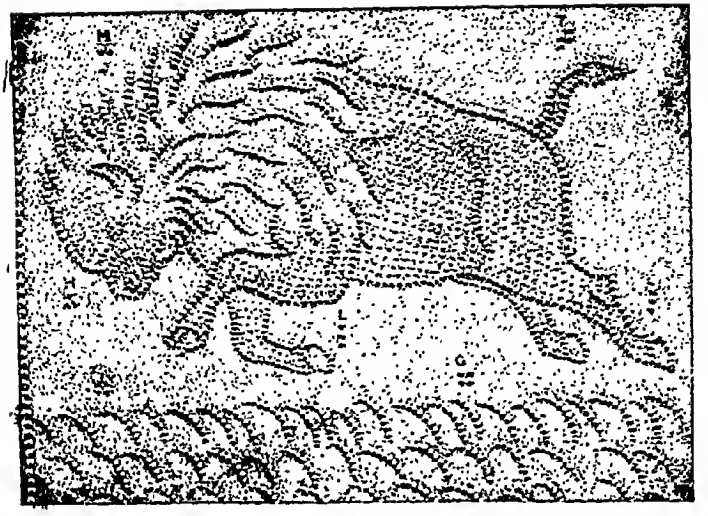
With great skill her devoted teachers had forced an opening through the prison walls

and reached the mind enclosed within. Now all that was needed was patience, perseverance, and love. She went on with her training, 'seeing' to read and write as the blind do, 'hearing' and 'speaking' as the deaf do, until she was twenty years old; then she became a very successful teacher.

Helen Keller was such another child—a soul shut up in a dark prison house of a body without windows or doors; yet her wonderful teacher, Miss Ann Sullivan, managed by her marvellous skill and love and patience to pierce this darkness, to get in touch with the little prisoner, and to help her to develop into an educated, cultured, and charming woman.

Helen was a tiny tot of about eighteen months old when she had an illness which robbed her of sight and hearing and speech. So, at an age when the ordinary child is just beginning to talk and to learn the names of everything around, little Helen was shut away within herself, in silence and darkness.

She handled and touched things freely, and by means of a few simple signs could make her mother understand when she wanted anything, —and terrible tempers she would fly into if her mother did not understand quickly enough, or did not give her what she wanted.



A picture which blind people can 'See' by following the outlines with their finger, and so learning the shape of the animal. The letters (H–head, M–mane, T–tail, L–leg, G–grass) in braille around the picture are a help in understanding it.

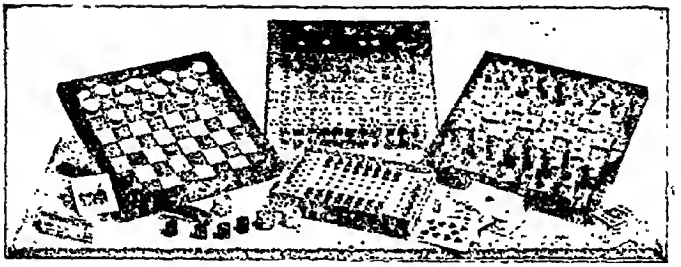
As she grew a little older the desire to express herself and to explain her wishes grew stronger and stronger, and her outbursts of passion when she could not make herself understood became more frequent.

Her parents were terribly grieved, and knew not what to do with her. At last they managed to get as her teacher a young lady, Miss Ann Sullivan, who having lost her sight had spent about six years in a school for the blind. Then her sight was partially restored, and when Helen's father applied to the school for a teacher for his little girl, Miss Sullivan was sent to her.

And what a task she had at first with this spoilt child, who, while she had the strength and will power of a child of six, had the mind and habits of a baby. She would eat her breakfast with her fingers, grab at the dishes, throw down her spoon, and when she was corrected, lie on the floor kicking and screaming for half an hour at a time. She had never learnt to obey any one, for her family had always been so sorry for her that they had never forced her to do anything she did not wish to do, and had given in to her on every occasion. But Miss Sullivan saw that she would never do any good until she had learned to obey.

The teacher's love and patience quickly worked a change; within a fortnight Miss Sullivan wrote:

'My heart is singing for joy this morning. A miracle has happened. The light of understanding has shone upon my little pupil's mind, and behold all things are changed! The wild little creature of two weeks ago has been transformed into a gentle child. She is sitting by me as I write, her face serene and happy. The little savage has learned the first lesson in obedience. It now remains my task to direct and mould the beautiful intelligence that is beginning to stir in the child's soul.'



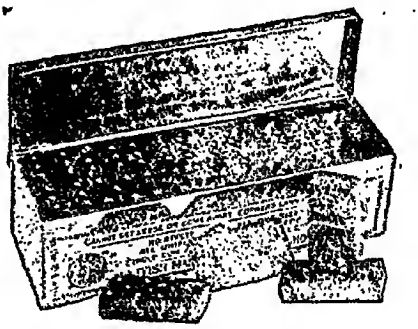
Although they cannot see, blind people are not cut off from all amusements. By means of these special boards in which the black squares, being sunken, can be felt with the finger, chess and draughts can be played. The cards (both ordinary and 'Happy Families') shown here have small braille markings at their corners, so that a blind player can tell what they are, while the dominoes on the next page have the dots sunken, and can be quickly recognized.

During these two weeks the girl had also been learning a few words. But we must remember this little blind and deaf and dumb child did not know what a word or a name or a letter was. How then did Miss Sullivan begin to make her understand? She gave her a doll to play with, and then slowly spelt into her hand d-o-l-l in the finger language of the deaf and dumb. Helen was at once interested in this finger-play, and imitated it until she could make the letters correctly. In the same way she learnt to spell out other words on her fingers, but as yet it was mere parrot-like imitation. She had no idea what a word was or that everything had a name.

Her first real consciousness of what this finger-play meant came to her suddenly. Let her tell us of her awakening in her own words.

'Some one was drawing water and my teacher placed my hand under the spout. As the cool stream gushed over one hand she spelled into the other w-a-t-e-r, first slowly, then rapidly. I stood still, my whole attention fixed upon the motions of her fingers. Somehow I felt a misty consciousness as of something forgotten—a thrill of returning thought; and somehow the mystery of language was revealed to me. I knew then that w-a-t-e-r meant the wonderful cool something that was flowing over my hand. That living word awakened my soul, gave it light, hope, joy, set it free. There were barriers still, it is true, but barriers that could in time be swept away.

'I left the well-house eager to learn. Everything had a name and each name gave birth to a new thought. As we returned to the house every object which I touched seemed to quiver with life. That was because I saw everything with the strange new sight that had come to me.'



She had suddenly realized that the manual alphabet was the key to everything she wanted.

to know, and so keen and eager was she that she added thirty new words to her vocabulary that day.

'The next morning,' her teacher wrote, 'Helen got up like a radiant fairy. She flitted from object to object, asking the name of everything, and kissing me for very gladness.'

She was like a prisoner released from chains. She could now begin to talk to people—on her fingers of course—and was anxious to teach her friends the manual alphabet so that they could talk to her. But she talked yet as a baby of two talks—in single words, not in sentences.

II

Little Helen's progress, now that she wanted to learn, was rapid, under her devoted teacher. She says:

'It was my teacher's genius, her quick sympathy, her loving tact which made the first years of my education so beautiful. She taught me to find beauty in the fragrant woods, in every blade of grass, and in the curves and dimples of my baby sister's hand. When the time of daisies and buttercups came, Miss Sullivan took me by the hand across the fields, to the banks of the river, and there, sitting in the warm grass, I had my first lessons in nature.

I learned how the sun and the rain make to grow out of the ground every tree that is pleasant to the sight and good for food: how birds build their nests, and live and thrive from land to land; how the squirrel, the deer, the lion, and every other creature finds food and shelter. As my knowledge of things grew I felt more and more the delight of the world I was in.'

And all this knowledge, we must remember, was passed on to a little girl, who could neither see nor hear, by means of finger taps into her hand! Wonderful Miss Sullivan!

The next step, now that the little girl knew what words meant, was to learn to read from raised type and to form the letters for herself. And her progress was so quick that very soon she was writing little letters to her friends—all in single words at first, such as: 'helen write anna—george will give helen apple—jack will give helen stick of candy—doctor will give mildred medicine—mother will make mildred new dress.'

This was written only three and a half months after the first word had been spelled into her hand.

A year later she had made such great progress that she could write quite a long letter beginning:

'I am glad to write to you this morning because I love you very much. I was very happy to receive pretty book and nice candy and two letters from you. I will come to see you soon and will ask you many questions about countries, and you will love good child.

'Mother is making me pretty new dresses to wear in Boston and I will look lovely to see little girls and boys and you. Friday, teacher and I went to a picnic with little children. We played games and ate dinner under the trees, and we found ferns and wild flowers.'

And this is from a girl of eight, deaf and dumb and blind, who, about twelve months earlier, did not know a single word. Is it not nearly as good as most boys and girls of eight can do, though they have their sight and their hearing, and have seen and heard words from babyhood?

Very soon she was taking regular lessons in all kinds of subjects and was making good progress in arithmetic. Before she was eleven she was doing problems with improper fractions.

One day when a question puzzled her very much her teacher suggested that she should take a walk, and that then she would perhaps understand it better. But she shook her head and said, 'My enemies would think I was

running away. I must stay and conquer it now,' and she did.

It was this same spirit, this determination never to be beaten, that carried her through her difficult struggles, and that make us look upon her not only as a very clever girl, but as a noble and heroic one also.

III

She continued her education by manual signs from Miss Sullivan, and by reading, for three years, until she was ten years old. Then she determined that she would learn to speak as other people did.

Now deaf people are usually dumb because they cannot *hear* the sound made by the movement of the lips and tongue. Sometimes deaf people can be taught to speak by very careful watching and by imitation of the movements of other people's lips, but though they may learn to make the lip movements they often make no sound. Little Helen could not even watch the movements of the lips: how then could she possibly learn to speak?

All her friends, even Miss Sullivan, discouraged her; but as we have seen, when once she had made up her mind to do a thing, she would not be beaten. So Miss Sullivan took

her to a lady, Miss Fuller, who had made a study of lip-reading.

'Miss Fuller's method was this,' Helen wrote. 'She passed my hand lightly over her face and let me *feel* the position of her tongue and lips when she made a sound. I was eager to imitate every motion, and in an hour had learned six elements of speech, M. P. A. S. T. I. Miss Fuller gave me eleven lessons in all. I shall never forget the surprise and delight I felt when I uttered my first connected sentence, "It-is-warm." True, they were broken and stammering syllables, but they were human speech. My soul, conscious of new strength, came out of bondage and was reaching through those broken symbols of speech to all knowledge and all faith.

'But it must not be supposed that I could really talk in this short time. I had learned only the elements of speech. I laboured night and day before I could be understood even by my friends, and I needed Miss Sullivan's help constantly in my efforts to articulate each sound. My work was practice—practice—practice. Discouragement and weariness cast me down frequently, but the next moment the thought "my little sister will understand me now", spurred me on.'

So splendidly did she persevere that six years later she was able to speak in public to

Helen Keller talking to the President of the United States—she 'listened' to his replies by placing her fingers on his lips.

a number of people who were interested in the education of the deaf.

'If you only knew all the joy I feel in being able to speak to you!' she said. 'I can remember the time before I learned to speak, and how I used to struggle to express my thoughts by means of the manual alphabet—how my thoughts used to beat against my finger-tips like little birds stirring to gain their freedom, until one day Miss Fuller opened wide the prison door and let them escape.

'Of course it was not easy to fly at first. The speech wings were weak and broken and had lost all the grace and beauty that had once been theirs, indeed nothing was left save the impulse to fly, but that was something. One can never consent to creep when one feels an impulse to soar.

'There were many difficulties in the way, many discouragements, but I kept on trying, knowing that patience and perseverance would win in the end.

'So I want to say to those who are trying to learn to speak, and to those who are teaching them: You have set yourselves a difficult task, but you will succeed if you persevere. Remember no effort that we make to attain something beautiful is ever lost. Some time, somewhere, somehow, we shall find that which we seek.'

When Helen was fourteen she began to attend a school for the deaf, and among other things studied Latin and French and German. At sixteen she entered an ordinary school with the idea of preparing for the University. As of course she could not hear the instruction given, Miss Sullivan attended the classes with her and interpreted the lessons by means of the manual alphabet. The other teachers worked with her privately at times, but, she said, 'though everybody was kind and ready to help, there was only one hand that could turn drudgery into pleasure'.

At seventeen she took the preliminary examination for the University, and passed in German, French, Latin, English, and Greek and Roman History, winning honours in German and English. What a splendid achievement! At nineteen she passed the final examination, and entered College.

Here, though she found much delight in the company of other girls, she also found fresh difficulties. Many of the books she had to study were not printed in the Braille type, and she had to have them spelled into her hand, so it took her longer to prepare her work than it took the other girls, and she often felt rebellious when she knew they were laughing and playing out of doors, while she had to be

Helen Keller enjoying a joke with Charles Chaplin. The great comedian is spelling the words into her hand. The cinema itself, alas! is an amusement in which blind people can never share.

sitting over her tasks; but she soon recovered, and laughed the discontent out of her heart while she continued her heroic struggle against fate.

She successfully completed her college course and read widely the history and literature of many countries. But reading was by no means her only pleasure.

She loved the country and out-of-door sports. She could swim well when quite a little girl, and was fond of rowing.

'Nothing gives me greater pleasure than to take my friends out rowing when they visit me. Some one usually sits in the stern and manages the rudder while I row, but sometimes I go rowing without the rudder. It is fun to

try to steer by the scent of water-grasses and lilies and of bushes that grow on the shore.'

She loved walking, riding, and cycling, and to romp with young children was always a source of joy to her.

And so this wonderful girl lived a life almost as full and quite as interesting and useful as that of many people who have the precious gifts of sight and hearing and speech.

She spent much time in working for those who were handicapped as she was, so that they should have the benefit of a full education, and she wrote beautiful letters and books.

'Is it not true then,' she wrote, 'that my life with all its limitations touches at many points the life of the World Beautiful? Everything has its wonders, even darkness and silence, and I learn, whatever state I may be in, therein to be content.

'Sometimes, it is true, a sense of isolation enfolds me like a cold mist as I sit alone and wait at life's shut gate. Beyond there is light and music and sweet companionship, but I may not enter. Fate, silent, pitiless, bars the way. . . . Then comes hope with a smile and whispers "There is joy in self-forgetfulness", so I try to make the light in others' eyes my sun, the music in others' ears my symphony, the smile on others' lips my happiness.'

. . . .

Some books for the blind are printed in raised letters, but many of them now do not use letters at all; they have an alphabet of their own, in which syllables and words are represented by raised 'points'. This is known as the Braille method of printing.

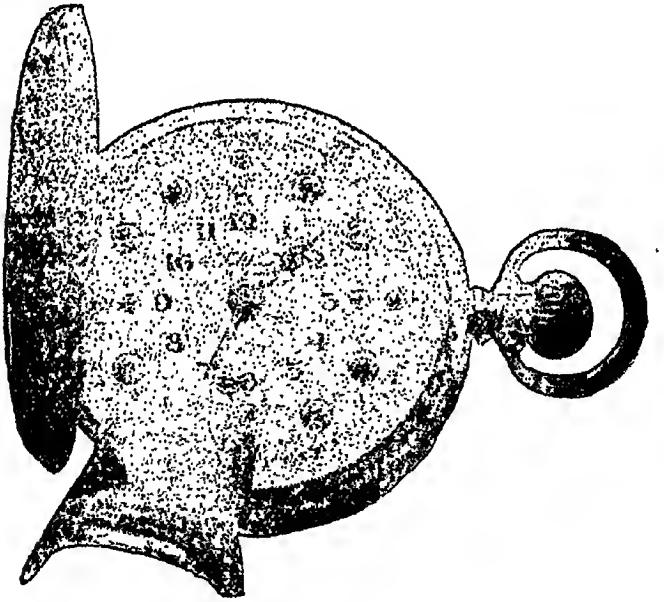
As a child Louis Braille loved to play in his father's saddlery shop. One day he was punching holes in scraps of leather with an awl when the sharp tool slipped and caught his eye, injuring it so severely that he soon became quite blind. In his blindness he thought a great deal about the little marks his awl had left in the leather, and he saw that if he punched the leather only half-way through, a dot would be raised on the other side.

Louis Braille

With this idea in his mind the blind boy, who would not be beaten by his fate, worked out a system in which different groupings of

raised dots represented different letters, syllables, or words.

This system appealed very much to those interested in the education of the blind, and soon Braille's method, with a few modifications, was taught in schools for the blind throughout the world, and numerous books were printed in it, thus opening a new world of happiness to thousands imprisoned in a world of darkness.



A watch by means of which a blind person can tell the time. The hours are marked by raised dots, double dots being placed at all the quarters. See the finger feeling the position of the minute-hand.

II

Akbar, the Great Mogul

AKBAR was a foreigner in India. He had not a drop of Indian blood in his veins. On his father's side he was a direct descendant in the seventh generation of the great Amīr Tīmūr, a Central Asian Turk. He was descended through Bābur's mother, from Chagatai, the second son of Chingiz Khān, the Mongol 'scourge of Asia' in the thirteenth century. His own mother was Persian. The character of Akbar, as far as it depended upon heredity, was thus based on three distinct non-Indian strains of blood existing in his near ancestors, namely the Turk or Turkī, the Mongol or Mogul, and the Persian or Iranian strains. During the early years of his reign Indian influences counted for little, the officers and courtiers surrounding him being divided into two parties, the Turks on one side, and the Persians on the other. But after Akbar had attained maturity the pressure exercised by Indian environment rapidly increased, so that in sentiment he became less and less of a foreigner. Akbar made an Indian of himself and lived to be one of the greatest of Indian monarchs.

Akbar, as seen in middle life, was a man of moderate stature, perhaps 5 feet 7 inches in height, strongly built, neither too slight nor too stout, broad-chested, narrow waisted, and long-armed. His legs were somewhat bowed inwards from the effect of much riding in boyhood, and when walking he slightly dragged the left leg, as if he were lame, although the limb was sound. His head drooped a little towards the right shoulder. His forehead was broad and open. The nose was of moderate size, rather short, with a bony prominence in the middle, and nostrils dilated as if with anger. A small wart about half the size of a pea which connected the left nostril with the upper lip was considered to be a lucky mark. His black eyebrows were thin, and the Mongolian strain of blood in his veins was indicated by the narrow eyes characteristic of the Tartan, Chinese, and Japanese races. The eyes sparkled brightly and were 'vibrant like the sea in sunshine'. His complexion sometimes described by the Indian term 'wheat-coloured', was dark rather than fair. His face was clean-shaven, except for a small, closely trimmed moustache worn in the fashion adopted by young Turks on the verge of manhood. His hair was allowed to grow, not being clipped close in the ancestral manner. His very loud voice was credited with 'a peculiar richness'.

His whole mien was in such perfect accord with the idea of kingly dignity that 'anybody, even at the first glance, would recognize him as a king'. His son declares that Akbar 'in his actions and movements was not like the people of the world, and the glory of God manifested itself in him'. When he turned an angry look upon an offender, his appearance was strangely terrible.

His outer garment was a surcoat or tunic of the kind called *cabaya*, reaching a little below the knees, but not coming down to the ankles like the long robes commonly worn by some Muslims. It was made ordinarily of thin material interwoven with gold thread, decorated with embroidered patterns of flowers and foliage, and fastened by a large clasp. On his head Akbar wore a small tightly rolled turban, made so as to combine Hindu with Mussulman modes. The head-dress was enriched by pearls and other gems of inestimable value. His trousers, made of the finest cloth, extended down to the heels, where they were tucked in and held by a knot of pearls. His shoes were made in a peculiar style after a design of his own. He liked European clothes, and when in private often wore a Portuguese suit of black silk or velvet. He invariably kept a dagger in his girdle, and if any moment he did not happen to be wearing a

sword one always lay ready to his hand. Whenever he appeared in public a score of pages and guards were in attendance ready to place a variety of weapons at his disposal.

All observers agree that Akbar's manners were charming. He is described as being 'pleasant-mannered, intimate, and kindly, while still preserving his gravity and sternness'. Father Jerome Xavier, who, as Bartoli says,

> was an eye-witness of his conduct for many years, gives him the praise so rarely due to a Prince engaged in high affairs of state, by remarking that 'in truth he was great with the great, and lowly with the lowly'. Du Jarric varies the observation by stating that 'to his own family he was most dear; to the great he was terrible; to the lowly, kind and affable'.

The same author goes on to say that

> with small and common people he was so sympathetic and indulgent that he always found time gladly to hear their cases, and to respond graciously to their requests. Their little offerings, too, he used to accept with such a pleased look, handling them and putting them in his bosom, as he did not do with the most lavish gifts of the nobles, which, with discreet pretence, he often seemed not even to glance at.

Akbar was extremely moderate in his diet, taking but one substantial meal in the day, which was served whenever he called for it, not

at any fixed hour. He cared little for flesh food, and gave up the use of it almost entirely in the later years of his life. He had a great liking for fruit, especially grapes, melons and pomegranates, and took much pains to improve the supply, both home-grown and imported.

He took special delight in the practice of mechanical arts with his own hands. We are told that 'there is nothing that he does not know how to do, whether matters of war, or of administration, or of any mechanical art. Wherefore he takes particular pleasure in making guns and in founding and modelling cannon'. Workshops were maintained on a large scale within the palace enclosure, and were frequently visited by him. He was credited with many inventions and improvements. That side of his character suggests a comparison with Peter the Great.

Akbar never learned even the elements of reading and writing. He was far from being an ignorant man, but his varied knowledge was picked up in a haphazard way without system or method. He possessed a memory of almost superhuman power, which enabled him to remember accurately the contents of books read to him, the details of departmental business, and even the names of hundreds of individual birds, horses, and elephants. In the business of

government he had the rare capacity of combining a firm grasp on principles with minute attention to details. His mastery of detail was well shown in his conduct of the expedition to Kabul in 1581, the most elaborately organized of his military operations. Father Monserrate, who accompanied him, was filled with admiration for the care exercised by the emperor personally in all the arrangements of the campaign. His so-called illiteracy does not seem to have caused the slightest practical inconvenience. Indian rulers have always been accustomed to dictate orders and to leave most of the actual writing to subordinate professional secretaries and clerks.

Akbar was intimately acquainted with the works of many Mohammedan historians and writers on religious subjects, as well as with a considerable amount of general Asiatic literature, especially the writings of the Sūfī or mystic poets. He acquired from the Jesuit missionaries a fairly complete knowledge of the story of the Bible and the main outlines of the Christian faith, while at the same time learning from the most accredited teachers the principles of Hinduism, Jainism, and other forms of worship; but he never found an opportunity to study Buddhism. As a boy he took some drawing lessons, and he retained all his life an active

interest in various forms of art. The architecture of the reign unmistakably bears the impress of his personal good taste. A man so variously accomplished cannot be considered illiterate in reality. He simply preferred to learn the contents of books through the ear than the eye, and was able to trust his prodigious memory. Anybody who heard him arguing with acuteness and lucidity on a subject of debate would have credited him with wide and profound literary knowledge, and never would have suspected him of illiteracy.

Throughout his life Akbar was an intelligent patron of literature and art. Although he had not taken the trouble to learn to read, yet, by a peculiar power to understand and a talent for selection by no means common, he 'had made his own all that can be seen and read in books'. In order that material for his studies through the medium of the ear might not be lacking, he collected an enormous library of extraordinary value, to which probably no parallel then existed or ever has existed in the world. All the books were manuscripts. Akbar cared nothing for printed volumes, and got rid of the choice specimens presented to him by the first Jesuit mission. When the inventory of his treasures preserved in the fort of Agra was taken after his death, in October 1605, the books, 'written by

great men, mostly by very ancient and serious authors', adorned with extremely valuable bindings, and in many cases enriched with costly illustrations by the best artists, numbered 24,000, valued at nearly six and a half millions of rupees.

The active interest shown by Akbar in the Sanskrit literature of India, was chiefly manifested by his orders for the preparation of Persian translations and adaptations of the epics and other famous works. The versions, when completed with magnificent bindings and illustrations, were consigned to the immense imperial library at Agra. The Sanskrit books translated or paraphrased comprised the *Atharva Veda*; both of the great epics, namely, the *Mahābhārata* and the *Rāmāyaṇa* of Vālmīki; the *Līlāvatī*, a treatise on arithmetic; and many others. The work of translation was not confined to Sanskrit authors, Greek and Arabic books were also dealt with. The Khān Khānān rendered into Persian the celebrated *Memoirs* of Bābur, which had been written in Turkī.

Akbar, although not in a position to bestow extensive patronage on artists until his throne had been secured, had shown a great predilection for painting from his earliest youth. Characteristically, he sought a religious justification for

his personal taste, remarking to friends assembled at a private party:

> There are many that hate painting; but such men I dislike. It appears to me as if a painter had quite peculiar means of recognizing God; for a painter in sketching everything that has life, and in devising its limbs, one after the other, must come to feel that he cannot bestow individuality upon his work, and is then forced to think of God, the giver of life, and will thus increase in knowledge.

Later in the reign Abu-l Fazl was able to affirm that more than a hundred painters had become famous masters of the art, while many more had attained moderate success. Examples of the work of all these persons are to be seen in London.

From early boyhood Akbar was devoted also to every form of sport, and learned in everything concerning horses, camels, elephants, and dogs. He was a perfect horseman, and had the faculty of exercising absolute control over the most ferocious elephants. He was a splendid shot, and took much delight in all kinds of hunting. He took great pleasure in chasing antelopes with specially trained leopards (*cheetahs*). He was ready to encounter any beast, however fierce, tiger, lion, or other, and was prepared to undergo any amount of fatigue in order to run down the game. On the only occasion that he

saw wild asses, which happened in the desert of Bīkanēr, he was so keen in the pursuit that he became separated from his attendants, and nearly perished of thirst. He was absolutely fearless, and, like Alexander of Macedon, was always ready to risk his life.

When residing at his capital or in a standing camp he provided himself with amusements of many kinds. He kept immense flocks of choice pigeons, and loved to watch their antics. He was a keen polo player, and insisted on his courtiers keeping up the game with spirit. Like most princes in India he enjoyed watching animal combats, of elephants, buffaloes, rams, and other beasts and birds.

His more peaceful amusements were as varied as those of a strenuous kind. He took extreme pleasure in music and song, and was reputed to be a skilled drummer. He loved to watch clowns and jugglers, and had a strange habit of disposing of serious business while looking at shows with, so to speak, the corner of his eye. Witty conversation and lively story-telling would keep him awake at night. He slept little and lightly, seldom more than three hours in the night time. The hours which he kept must have been dreadfully trying to the court.

Akbar had a naturally quick temper which occasionally carried him away in a gust of

passion. Peruschi justly sums up this side of the emperor's character by observing that

> the Prince *rarely* loses his temper, but if he should fall into a passion, it is impossible to say how great his wrath may be; the good thing about it is that he presently regains his calmness, and that his wrath is short-lived, quickly passing from him; for, in truth, he is naturally humane, gentle, and kind.

As a rule he had perfect self-control. Bartoli expresses the truth neatly by the remark that

> whether by training or innate power, he was so completely master of his emotions that he could hardly ever be seen otherwise than as perfectly pleasant and serene.

'If I were guilty of an unjust act,' Akbar said, I would rise in judgement against myself.' The saying was not merely a copybook maxim. He honestly tried to do justice according to the standards of his age. The emperor occasionally called up civil suits of importance to his own tribunal, and he possessed an intellect so acute and knowledge of human nature so profound that when he undertook judicial duties in person his efforts to do justice probably met with considerable success.

The subject of Akbar's opinions on religion has attracted much attention from many of the authors who have dealt with his life and history.

The emperor was a sincerely religious man, constitutionally devout. Jahāngīr declares that his father 'never for one moment forgot God'. That testimony is corroborated by Abu-l Fazl, who avers that his sovereign 'passes every moment of his life in self-examination or in adoration of God'. He performed private devotions four times a day at sunrise, noon, sunset, and midnight, spending a considerable time over them. In earlier years he had observed strictly the five Mohammedan canonical times for prayer. Apart from formal religious exercises, his whole course of life testified to the extreme interest taken by him in the problem of the relations between God and man, and many of his sayings express his views on the subject. One of them may be quoted here:

> Although I am the master of so vast a kingdom, and all the appliances of government are at my hand, yet since true greatness consists in doing the will of God, my mind is not at ease in this diversity of sects and creeds; and apart from this outward pomp of circumstances, with what satisfaction, in my despondency, can I undertake the sway of empire?

The most original idea of Akbar consisted in his recognition and practical acknowledgement of the principles that Hindus as well as Mohammedans should be considered eligible for the highest offices in the State, civil or military, and

that the followers of every creed should have complete liberty to worship God after their own fashions. Throughout his reign he maintained the validity of these two principles.

The practical ability displayed by Akbar as soldier, general, administrator, diplomatist, and supreme ruler is shown abundantly by his whole life. To his contemporaries, the personal force of his character was overpowering. He was a born king of men, with a rightful claim to rank not only as one of the greatest Indian sovereigns but as one of the greatest monarchs known to history. That claim rests securely on the basis of his extraordinary natural gifts, his original ideas, and his magnificent achievements.

III

How the South Pole was Discovered

I

When 'Old Mooney' was fourteen he joined the navy, and his parents wondered how their untidy, dreamy, lovable boy would hold his own, and sustain the honourable traditions of his family in that gallant service.

They were soon happy about him. He quickly made friends among his fellow cadets, who chose him as their captain. He learnt the hard lesson of order and the harder one of steady work. If he still had his dreams he kept them to himself.

'Old Mooney' was his father's nickname for Robert Falcon Scott, who saw many years' service afloat, before, by a chance meeting with Sir Clements Markham, a boyish dream came true.

'An expedition is to be sent out to explore the Antarctic regions,' he was told.

Scott thought a bit. 'May I be placed at the head of it, Sir Clements?'

'You are the very man I want for the post.'

On 31st July 1901 the good ship *Discovery* sailed from London docks, with Scott in command, and as fine a body of officers and men as any captain could desire. With rousing cheers they set sail from England; with rousing cheers they were welcomed in New Zealand, when they called at one of her ports on their way Southward Ho! Then 'good-bye' and 'good luck' and the song, 'He's a jolly good fellow' sounded in their ears as they steamed away towards the Antarctic Ocean.

Captain Scott

The little vessel was soon to test her mettle in a trial of strength with the ice. The floes grew heavier and heavier, and the engines pumped their heart out to push her through them inch by inch. There was a time when Scott, pacing the tiny bridge, feared that he and his comrades might find an icy grave, before ever they touched at Cape Adair, whither

they were bound as a starting-point. The *Discovery* did not mean to be beaten. She was going to fight the ice and she was out to win. She pushed through the floes and into the open sea once more, proud of her mission, and proud from stem to stern when she heard her captain say, 'She is a gem.'

Birds flitted round her, curious but unafraid of the friendly sailors. The snow-white petrel, with its black beak and beady eye, the giant albatross, funny penguins, flapped their wings; and lazy seals lay asleep on the ice.

The ship's company sailed on, exploring the coast-line, till winter came, and a safe harbour had to be found. The *Discovery* was frozen in with twenty miles of ice between her and the open sea. But they were merry and happy aboard, and busy ashore, in the huts which they put up. The huts were lighted and warm, the men were all good friends, and they spent the long dark days in making preparations for the sledging journeys overland in the spring.

In August the sun shone once more and Scott called to them all to come and see it rise! A few followed, but others went on calmly with their dinner, for they had seen the old sun rise in England many a time, and were not excited about it.

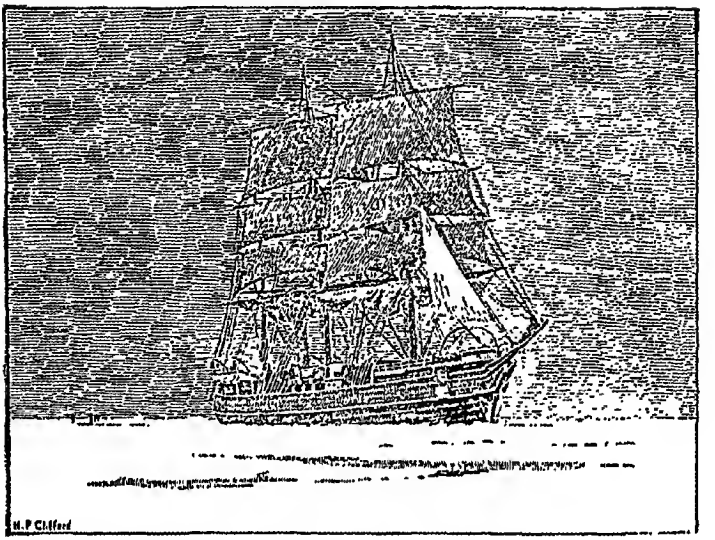
In spite of the summer the *Discovery* remained fixed in her icy prison; there was no sailing further round the coast. But Scott and various members of the company went on sledging expeditions, covering hundreds of miles and making many important discoveries. They marked the great range of the Victoria Mountains, of which only glimpses had been seen by former explorers, and they mapped out new land, and called it after King Edward VII.

One day Scott, with two assistants, Laidlay and Evans, was harnessed to the sledge, which they were dragging over heavy, uneven, bumpy ground. Suddenly he slipped over the edge of a crevasse, dragging Evans after him. There they hung between life and death, the blue sky above, a deep gulf below.

'How are you getting on, Evans?' Scott asked.

'All right, Sir,' was the calm reply.

Meanwhile, Laidlay had just managed to prevent the sledge following them and dragging them all to death. As he held grimly on, Scott noticed a ledge of ice and scrambled on to it, helping Evans to do the same. There was nothing for it now but, half frozen though he was, to climb hand over hand up the rope that dangled from the sledge. He was breathless



The *Discovery*

and speechless as he stood by Laidlay's side and heard his 'Thank God'.

After a moment's rest the two of them hauled Evans up to safety.

'Well I'm blowed!' was all he said, as he reached the top, and he began coolly to prepare the sledge for continuing their journey.

The winter came on and passed as happily as the first. But when summer returned the *Discovery* still lay embedded in the ice. One day, when Scott and a companion were busy on land, to their surprise they saw two ships sailing towards them. They hastened to greet them,

and found they were the *Terra Nuova* and the *Morning* come to their relief. It was a joy to see friends once more and to have letters from home. Why then did he go back to the *Discovery* sick at heart?

All hands were called on deck.

'It has been decided in England,' he told them, 'that the *Discovery* is stuck fast in the ice for evermore. I am bidden to abandon her, and bring officers and men home. In six weeks we must be ready to start.'

Silence greeted his speech. No sailor will abandon his ship till all is lost. As they went back to their work not a laugh was heard, not a word was spoken. They looked at the vast field of ice that lay between them and the ships that were to take them home. Would it break in time? A signal station was set up to watch it, and day by day they read the message 'No change'. Then came a glad hour when the sheet of ice began to move, and the relief boats sailed a mile or two towards them. It was now a race against time.

Scott at dinner one evening heard a mighty shout, and a voice rang down the hatchway:

'The vessels are coming, sir.'

Sure enough the ice was breaking all around, and the *Terra Nuova* and the *Morning* were

adding to the general excitement by racing to the side of the *Discovery*.

The three vessels went on to explore the coast-line, and when they had attained the object of their journey, they turned northward for home.

They had been further south than any previous expedition. Scott would take no credit to himself. All had shared the adventure, all should share the honour.

II

Six years later Captain Scott was to seek those ice-bound regions once more in search of the South Pole, whither Captain Amundsen, the Norwegian explorer, had already set out.

Scott was married now, and had a little son, and home was sweet. But his wife, as brave as himself, bid him go—and come back!

What a splendid company of officers and men were aboard the *Terra Nuova*, his old ship which was to take them to the Antarctic lands! And with them were men who were to study the animals, the birds, the rare plants, and the story that the rocks would tell.

Once more they wintered amidst snow and ice, and waited till the glorious summer sunshine made of that white land a fairyland glimmering in its rays.

The time had been spent in making ready for the dash to the Pole. The sledges were packed, the ponies which were to drag them at the start were strong and frisky. It was arranged that some members of the expedition should go part of the way, and leave at various points stores of food which would be wanted on the return journey; but only four could have the honour of accompanying their captain on the last march: Dr. Wilson, Captain Oates, Lieutenant Bowers, and Petty Officer Evans, all tried and splendid men.

They went forward at the rate of some ten miles a day, camping at night in the snow, often hungry, always cold, but warmed by the hope in their hearts. Day by day they pressed on.

Only twenty-seven miles more! Another day's journey and but nineteen miles—in two days' time the Pole would be reached.

'What is that?' asked Lieutenant Bowers suddenly, pointing to a speck in the distance.

'A shadow of the sun on the snow,' they answered. They trudged on, their eyes fixed on that speck, which grew bigger and bigger and more distinct. Fear gripped them. Theirs were not the first feet that had trod that snow-clad wilderness. It was a cairn, and above it floated the black flag of Amundsen, who had reached the Pole one short month before.

'What is that ?' asked Lieutenant Bowers suddenly

None slept that night. The disappointment was bitter. Even Scott himself was in low spirits at the thought that someone else had won the honour of first reaching the South Pole.

III

'Now for the run home and a desperate struggle: I wonder if we can do it.' They were short of food, short of fuel, a gale swept over the desolate country, but the five travellers cheered one another day by day. Evans was the first to fail. They went slow and ever slower to suit his pace. At last he could go no further. They stopped with him to the end, and dug his grave nearer to the Pole than any man has ever yet been laid.

Captain Oates began to suffer terribly, and could hardly walk. He begged them to leave him so that they might have a chance of their lives. They refused. They pitched their tent, and for days so fierce a tempest raged that they could not move on. Oates grew worse. One morning he stumbled to the door of the tent, and drawing back the flap turned to his companions and said, 'I am just going out, I shan't be long.' The whirling snow was on his face, and they saw him no more. He had gone out into the blizzard to die so that

they might have a chance to live. 'It was the act of a brave man and an English gentleman,' said his chief.

There had been too many delays. The three who were left were starving. They could not face the blizzard. Wilson and Bowers folded themselves in their sleeping bags, and never woke again. And Scott, grasping his pencil in his dying hands, with no thought of self, wrote home to those who had loved his lost comrades, and to those whom he loved, letters that reveal in every word the hero soul.

'After all we have given our lives for our country. I may not have been a great explorer, but we have done the greatest march ever made and come near to great success. . . . The Great God has called me. I die in peace, not afraid.'

Their bodies lie amid the Polar snows. The Union Jack flies below the Norwegian at the South Pole. But whenever the story of that quest is told the name of Robert Falcon Scott will hold a foremost place, for to fail greatly may be sometimes greater than to succeed.

IV

The Great Unknown

I

Sir Walter Scott

We may often wonder to whom it is that a nation owes its greatest debt of gratitude. Is it to the clever inventors who have produced all the wonderful things with which we are now familiar—aeroplanes, wireless - telegraphy, and similar marvels? Is it to the explorers who have discovered new lands, or to the road builders and traders who have followed in their footsteps? Or is it to the quiet worker in studio and library, who strives to inspire in the rest of mankind a love of everything that is beautiful, and to lift their lives on to a higher and nobler plane?

It is difficult to say; but this we know, that the world would be a dreary place, 'stale, flat, and unprofitable' for many of us, if there were no books to teach us and to give us joy.

One of the writers to whom we owe the greatest debt, for the words of delight and inspiration which fell from his pen, was once a lame little boy limping about the streets of Edinburgh, or riding on a tiny Shetland pony among the hills and dales of his native Scotland. He was not poor, as were many of the boys who later did some of the finest work in the world; but he had this one great handicap all through his life—his lameness.

Walter Scott was born in Edinburgh in 1771. His father was a solicitor, and his mother, the daughter of a professor of medicine in the University, had been much better educated than the majority of ladies at this time: from her lips he heard many stories of the past, to which, we may be sure, he eagerly listened, and which he stored away in his marvellously retentive memory.

Little Walter was very fond of his mother, grateful to her, and proud of her too. Writing about her after her death many years later, he said, 'She had a mind peculiarly well stored with much acquired information and natural talent, and as she was very old, and had an

excellent memory, she could draw, without the least exaggeration or affectation, the most striking pictures of the past age. If I have been able to do anything in the way of painting the past times, it is very much from the studies with which she presented me.'

A good deal of his early life, however, was not spent at his own home in Edinburgh, but away at his grandfather's farm at Sandy Knowe. He was kept out of doors as much as possible, for the sake of his health, and often he would be sent out in the care of one of the shepherds, who would lay him down on the grass among the sheep.

Sandy Knowe was in Roxburghshire, one of the Border counties of Scotland. All young Walter's ancestors on his father's side had lived in this neighbourhood, and had taken part in many a fight and Border raid.

For hundreds of years before England and Scotland were united, these counties on the borders of the two countries were the scenes of constant raids. The noblemen in both countries kept large bands of followers who were always ready for a fight, and whenever his larder was getting empty, or there was nothing else to do, the chief would call his men together and, buckling on their swords, they would dash across the Border, to return driving before them

the cattle and sheep and horses of a neighbouring foe. Of course the foe was generally on the watch, and a running battle between the two parties would take place, the raider doing his best to drive the booty into his own lands, and then seeking refuge in the strong towers, or 'peels', which were to be found at intervals around his domain.

One of these 'peels', Sandy Knowe Tower, still stood on the top of a rugged crag, quite close to the Scotts' farm, and as young Walter grew older, he loved nothing better than to climb to this tower, and to sit there dreaming of the deeds of his ancestors. In spite of his lameness he soon taught himself to clamber among the rocks, and seated on a tiny Shetland pony, no bigger than a large dog, he went for rides all over the countryside.

We can picture the 'sweet-tempered bairn', with his chestnut hair and light blue eyes, galloping about the country on his tiny pony, lying down to rest every now and again on the rocky hills by the side of some old shepherd, who would soon be telling him stories of warlike heroes, or reciting ballads of bygone days.

He himself has given us a picture of his early boyhood in his poem *Marmion*:

It was a barren scene and wild,
Where naked cliffs were rudely piled;
But ever and anon between
Lay velvet tufts of loveliest green;
And well the lonely infant knew
Recesses where the wall-flower grew,
And honey-suckle loved to crawl
Up the low crag and ruined wall.
I deemed such nooks the sweetest shade
The sun in all its round surveyed
And still I thought that shattered tower
The mightiest work of human power;
And marvelled as the aged hind
With some strange tale bewitched my mind,
Of forayers, who, with headlong force,
Down from that strength had spurred their horse,
Their southern rapine to renew,
Far in the distant Cheviots blue,
And, home returning, filled the hall
With revel, wassail-rout, and brawl.
Methought that still with trump and clang
The gateway's broken arches rang;
Methought grim features, seamed with scars,
Glared through the window's rusty bars;
And ever by the winter hearth,
Old tales I heard of woe or mirth,
Of lovers' slights, of ladies' charms,
Of witches' spells, of warriors' arms,
Of patriot battles, won of old
By Wallace wight and Bruce the bold;
Of later fields of feud and fight,
When, pouring from their Highland height,
The Scottish clans, in headlong sway,
Had swept the scarlet ranks away.

While stretched at length upon the floor,
Again I fought each combat o'er,
Pebbles and shells, in order laid,
The mimic ranks of war displayed;
And onward still the Scottish lion bore,
And still the scattered southron fled before.
Still, with vain fondness, could I trace
Anew each kind familiar face
That brightened at our evening fire!

A picture this of a lovable boy, imaginative, bold, adventurous, full of spirit, but also kind-hearted and sweet-tempered. He could not bear to anger those whom he loved, and was instantly repentant of his misdeeds when he saw he had caused a friend pain.

When he went to school he found no difficulty in learning the things that appealed to him, such as history and literature; but with other subjects he was not so quick, so that sometimes he was at the top of the class, sometimes at the bottom.

He distinguished himself far more in the playground than he did in the class-room, for he constantly delighted his school-fellows with the innumerable stories he made up for their entertainment, and at the same time proved to them that though he was lame he was quite a match for them in their games. He took his part too in all their 'bickers', or street fights,

with the boys of the town which the High School boys then indulged in, and he became quite famous for his boldness in climbing the 'kittle ninestanes', a precipitous path at the very top of the rock on which Edinburgh Castle stands.

School-days came to an end, and Scott began to attend the law class at the University. These studies did not interest him much; but he worked hard at them, and at the same time set himself to study medieval legends and Border songs: he also took up the study of Italian and Spanish, that he might read the romantic literature of these countries. Always his friends noted two things about him, his gigantic memory, and his tireless industry. When he became an apprentice to his father he had only a very small allowance, and as he wanted more money to devote to his favourite studies, he set to work copying law papers. At one time he wrote as many as 120 large pages at one sitting, with no interval for food or rest, though the work must have taken him fourteen or fifteen hours at the very least.

In his father's office he cultivated regular business habits, which were to stand him in good stead later on; but whenever he was free, he would trudge over the neighbouring country, sometimes, in spite of his lameness,

covering as much as thirty miles a day, in search of the beauties of nature, or the ballads and legends he loved so well. So often did he go tramping about in this way that his father reproached him with being better fitted for a pedlar than a lawyer.

About this time also he began to go farther afield, and his first visit to the Highlands made a great impression on him. To his great delight he met with old men who could tell him of Bonny Prince Charles and Rob Roy. He talked

with every one he met, rich or poor, and stored up in his marvellous memory hundreds of scenes and incidents, which he afterwards used in his novels and poems.

He was, however, studying hard all the time, and eventually he passed his examinations and was 'called to the Bar'. He now received some employment from his father and other lawyers, but he still had plenty of leisure, which he employed either in telling stories to his companions, or in making 'Border Raids', as he called them, in search of fresh material.

He was a perfect companion for these long tramps into the country, having an endless fund of humour and drollery with which to amuse his companions, so that, as one of them said later, 'Never ten yards but we were either laughing or roaring or singing.' He never put on airs, and with his winning smile and engaging manner he could beguile any stranger to talk about himself and his memories.

II

In 1797, when he was about twenty-six years old, he married a beautiful girl named Mary Carpenter. They settled in Edinburgh and lived together happily for many years.

He now began to work seriously at the collection of Border Ballads which he had been making for so many years during his excursions into Liddersdale and elsewhere, and in 1802 they were published with the title *Border Minstrelsy*. The book sold well, and gained for Scott high literary praise, for he had written some very accurate illustrations and historical descriptions of the old ballads, and had added some new ones of his own which gave unmistakable promise of the genius of the writer.

Three years later, he produced his first great story in verse, *The Lay of the Last Minstrel*, and awoke one morning, as Byron did, 'to find himself famous'.

His gift for story telling, which up to the present had pleased merely his own friends and acquaintances, was now giving delight to the world at large. There is something in the poem to please all tastes: stir and movement, graceful songs, beautiful descriptions. Scott received for this poem £769, an unusually large amount for a poet to receive in those days.

Other long story poems, *Marmion* and *The Lady of the Lake*, followed in quick succession and were equally popular. Perhaps this was due, not so much to the story, as to the

romantic glow which pervaded the poems, their swift, marching rhythm, and, above all, to their remarkable simplicity, which made them appreciated by all.

Unfortunately, about this time Scott quarrelled with his publisher, and it was decided that a new firm, consisting of himself and John and James Ballantyne, friends of his boyhood days, should be started. This publishing business was never a success, and lost money faster than Scott could earn it by his writing. Later, as we shall see, it got him into serious difficulties.

For the moment, however, Scott was very prosperous, and he determined to buy the estate of Abbotsford. Here he had built for himself a beautiful house, which gradually grew to be as large and luxurious as a palace. The surrounding country was wild and barren, but it became the great passion of Scott's life to develop it, until his house was surrounded by beautiful gardens, rich pastures, and pleasing woodlands. 'Planting and pruning trees,' he says, 'I could work at from morning till night.'

Though Scott was now both rich and famous, his great life work was still to be done. It is not so much for his poems that we think of him with gratitude today, as for the wonderful

novels which, after this date, came from his pen.

Looking through his desk one day in search of fishing-tackle, he came across the manuscript of a tale which he had started and laid aside

Abbotsford

unfinished some years before. He took it out, read it through, and determined to finish it. With hard and constant work he got it finished in three weeks, and sent it to the publisher with the title of *Waverley*, but without putting his name to it.

Immediately it was received with great applause, for there had never been an historical novel like it before. Here the dry bones of history were made to live; each scene was presented to the reader as a vivid and charming

picture, in which real men and women moved across the canvas. Everybody was anxious to know the name of the author, but for a long time the secret was well kept, and he came to be spoken of as 'The Great Unknown'.

From this time novels followed each other in quick succession. His works were read all over Europe, and he was welcomed everywhere as a great and rare genius. He made a great deal of money by his books, and in 1820 he was given a baronetcy.

During these years he got up at five every morning and worked furiously till ten or twelve o'clock; the rest of the day he gave to his family and his friends, his horses and his dogs. Never was there a man who loved children and animals more than Sir Walter; and they in their turn were devoted to him.

III

But alas, these happy days came to an end all too soon. Through no fault of Sir Walter's, the publishing firm of Ballantyne & Co., with which he was connected, suddenly found itself burdened with debts to the large amount of £117,000. All Sir Walter's money had to go towards paying these debts, which, we must remember, were not of his making. So at the

age of fifty-five he found himself suddenly penniless.

All the money he had only paid off a small amount of the debt, and by declaring himself bankrupt he could have escaped the payment of the rest. But such a course, though advised by some of his friends, was loathsome to his chivalrous nature: he would rather die than stain his honour by avoiding the just payment of the debts. So, instead of being able to settle down to an old age of comfort, he set to work harder than before to earn money with which to pay his creditors.

Working hard for fourteen hours every day, he was able, within two years, to earn £40,000 towards paying off the debt. But his health suffered under the strain. He felt himself gradually getting weaker and weaker, but still he drudged on for another three years.

Then he was attacked by paralysis, and the doctors ordered him to the warmer climate of Italy.

The government placed a ship at his disposal, and on his arrival in Italy he was treated everywhere with the greatest honour, and recognized as the foremost writer of his age, not only of Britain but of the world.

But his health was getting worse and worse, and he longed to get back to his beloved

Abbotsford. The return home seemed to revive him for a while. He was able to receive his friends, and occasionally he was taken in a bathchair to see once again some of those scenes he so dearly loved. Three months after his return home he died very quietly and peacefully, and was buried within the ruins of Dryburgh Abbey, by the side of the stream he had loved so well.

. . . .

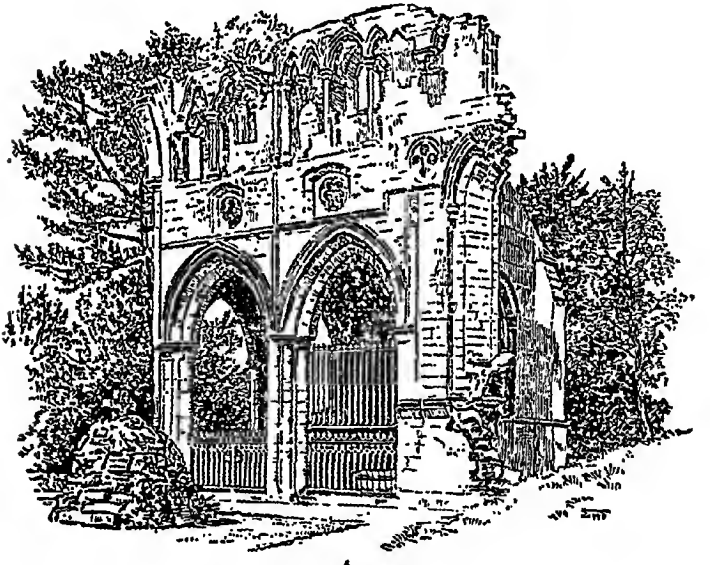
The enormous task which he had set himself six years before was not quite accomplished when he died in 1832. There was still a good deal of the debt owing to the Ballantyne creditors, but Sir Walter's life insurance, and the sale of the copyright of his novels, paid off the remainder. So his object was finally achieved: his own undivided labour had cleared and upheld his honour, and left him a name unstained.

Sir Walter Scott is one of the greatest glories of English literature: his novels are a tonic, instructive and stimulating: he has opened our eyes to all sorts of historical conditions, which without his aid we should never have seen.

But he was much more than a great writer: he was a great and good man, and the courageous struggle which he put up against misfortune

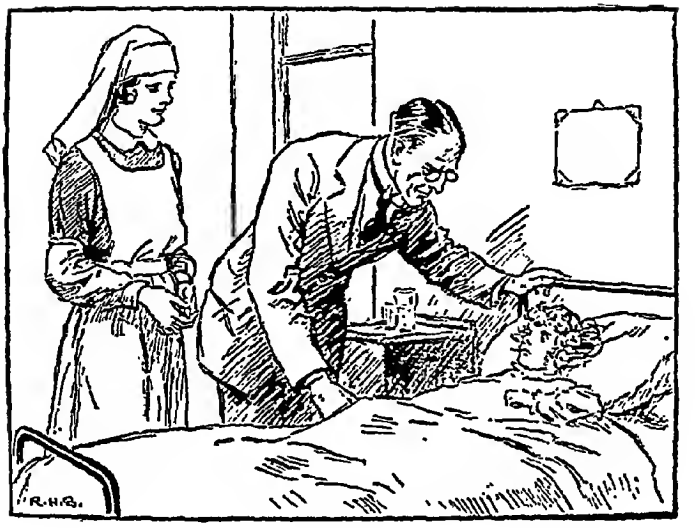
proved him a hero too. There was nothing unworthy or mean about him, a high and pure sense of duty inspired all his acts. He is a man and a hero worthy of our emulation; one who was

strong in will,
To strive, to seek, to find, and not to yield.



(Scott's Tomb)

Ruins of Dryburgh Abbey



V

A Righteous War

I

Most healthy boys and girls—yes, and men and women, too—love a fight! When the world was young, men fought each other, and gloried in the battle. But as the world gets older and more sensible, we grow more and more to hate the idea of shedding each other's blood, and to recognize, as time goes on, that all men are brothers; whether our skin is black, or white, or yellow, or brown, we are all the children of one big family. So it is our duty to love and help each other, not to wound and kill.

Are we, then, never to have a fight? Indeed yes, there are still many foes, worthy of our best endeavour. Ignorance and poverty are two great giants stalking about the world. We must call up every ounce of strength and pluck if we are first to conquer them for ourselves, and then help some other weaker brother in his battle, for these powerful enemies have for their allies such sinister ogres as selfishness, cruelty, and greed.

Then old Mother Nature sets us many battles to fight: there is the air to be conquered; the deep waters to be fathomed; the lofty mountains to be scaled; the wild places of forest, of ice, and sand to be explored. The difficulties and dangers of these battles would scare all but the bravest soldiers, and death is constantly lurking near.

But perhaps the most 'worth while' war of all is the war to be waged against disease. Here the foe is deadly, secret, and cunning. Sometimes he rushes down on us swiftly, determined to slay; but more often he is like the sapper, working long and silently in the dark underground, to undermine our position and our strength.

And the war against this terrible foe is a long, and tedious, and silent affair: hundreds of men have given their lives to try to save mankind

from its dreadful ravages, and have gone to their graves unknown and unsung. A few of the leaders of this noble army are known to men of science and to doctors—but to the rest of us, hardly at all. Yet why should they not be as well known and honoured as other leaders?

II

Just as in the regular army there are several kinds of regiments, so it is in the army of our dread foe, disease. We do not yet know how some of these divisions work: when we once know their tactics it becomes a much easier task to overcome them. So our great leaders in science are constantly trying to find out how the enemy works, and from the knowledge thus gained they can devise means to conquer him or to hold him at bay.

The germ diseases are those we know most about at present. These attack us by inserting into our bodies some very, very tiny plants or animals called bacteria. These bacteria are too small for us to see them with the naked eye—indeed, about one thousand of them could be put on the head of a pin—but there are millions and millions of them in the air, in the ground, in the water. Some of them are very useful: without them we could not turn

milk into butter or cheese, nor could we make wine or vinegar. Farmers find them useful, and tanners also, and though so minute, they are powerful enough to break down the hardest rock in time and turn it into good soil.

But though some of them are so useful to mankind, others are most deadly, and it is these which have to be discovered and fought against. They may enter the body through the air we breathe, or through the food we eat, or through the pores or cuts in the skin. If we are well and strong, something in our blood will surround these germs and most probably destroy them; but if we are weak, through bad habits, or improper food, or any other cause, the germs will begin a work of destruction in our bodies, and make us very ill.

III

The man who first proved that a disease was caused by these germs was a German scientist, named Robert Koch. He had long been studying a disease called anthrax, which killed off thousands of cattle and sheep every year. He noticed that in every case he examined this particular germ was present; so he cultivated some of these germs, and injected them into

the blood of healthy sheep. Within a few days all these sheep had died of anthrax, so proving without a doubt that the germ was the cause of the disease.

He and other scientists then went to work to prove that different diseases were each caused by different germs. By examining under the microscope the blood of people suffering from these diseases, Koch soon discovered the germ, or bacillus, which causes tuberculosis, and also the one which causes cholera. Other men have discovered the germs which cause blood-poisoning, influenza, whooping-cough, and many other diseases.

Robert Koch

IV

Disease germs cause illness by forming poisons, or 'toxins', in the body. Five years after Koch's first discovery the world-famous chemist, Louis Pasteur, after many experiments, declared that he could prevent sheep

and cattle from developing anthrax, by injecting into their blood an 'antitoxin', that is, a fluid containing the weakened germs of the disease itself.

Every one ridiculed him, but he offered to prove his statement. Taking fifty sheep, he vaccinated twenty-five of them—i.e. he injected some of the weakened germs into their blood; the other twenty-five were not touched. Some days later a powerful culture of anthrax germs was injected into the entire fifty.

On the afternoon of 2nd July 1881, a group of eminent French officials, scientists, journalists, and doctors met in a farmyard in a little French village. They stared at a row of twenty-five dead sheep laid out before them, then looked eagerly along the white road. Soon a small, bearded man appeared, and as he approached they greeted him with a loud cheer. Louis Pasteur, for the bearded man was he, bowed to the group, then counted the dead sheep; there were twenty-five. 'Where are the others?' he asked. Someone pointed out to him a pen filled with living sheep; again he counted twenty-five. His triumph was complete: the twenty-five vaccinated sheep had lived, while those not vaccinated had died.

A little later, Pasteur extended the same method to hydrophobia, and succeeded in

saving the life of a boy who had been bitten by a mad dog.

Pasteur was a great and tireless worker, never satisfied with tasks half done. He deserves the gratitude of the whole human race for his work, which laid the foundation of many of the great life-saving discoveries of the last forty years.

V

But a hundred years before Pasteur's time, vaccination had been introduced by a man who knew little or nothing about the germ theory of disease.

This was Edward Jenner, a young doctor near Bristol, who happened to overhear a country girl remark, 'I cannot take smallpox, for I have had cowpox.' He inquired into this, and found that it was generally believed in Gloucestershire that people who had developed cowpox on their hands, through milking diseased cows, never took smallpox, though this disease was very infectious.

Edward Jenner

Jenner studied the matter deeply for twenty years; then, in 1796, he made his first experiment.

He inoculated, or vaccinated, a boy from a cowpox sore. The boy developed the disease, in a very mild form, in the arm, and when the arm had healed Dr. Jenner inoculated him with the smallpox germs. The boy remained perfectly well, thus proving that vaccination had prevented him from developing the disease.

It was a long time before Jenner overcame the prejudice and ignorance of the people, but after a while the value of his discovery was proved, and he lived to find himself one of the

most famous men in Europe. Everywhere that vaccination became general smallpox gradually died out, and this once widespread and dreaded disease is now of very rare occurrence.

VI

As we have seen, Jenner arrived at his result by ceaseless experiment, without knowing anything about germs and the way they work. Koch, Pasteur, and their followers studied the habits of germs, discovered how they grew, how they moved from place to place, and how they entered the human body. Thus they did a good deal towards solving the mystery of how disease spreads. They found that germs flourish in impure water and food, and so they can enter our bodies through what we eat and drink, and through cuts and scratches in the skin, or, most wonderful of all, through the bites of insects.

The terrible Plague, which used to kill hundreds of people at a time, was carried from diseased rats by the flea. Malaria, a disease which kills thousands of people yearly in hot climates, is carried entirely by a certain type of mosquito.

This last discovery is due to Sir Ronald Ross, a great scientist of our own day, under whose

direction mosquito breeding-grounds have been to a great extent cleared, and the spread of malaria lessened in proportion.

Sir Humphry Davy

Sir James Young Simpson

VII

But there are other kinds of diseases, besides those caused by germs. Sometimes the diseased part of the body must be cut away, a tube must be opened and cleaned out, or a bone scraped or straightened. Up to a hundred years ago this meant fearful pain and agony for the poor patient, who had to lie on the operating table and feel the surgeon cut into his flesh.

Now, thanks to the work of Davy and Simpson, this is no longer necessary. In 1800

Humphry Davy, a young English lad, not more than twenty-two years old, discovered that certain gases would put a man to sleep and make him unconscious of pain. Very little notice was taken of his discovery until, in 1846, Simpson, the son of a baker, took it up and experimented with other gases which would make men unconscious. Very soon doctors all over the country were using these 'anaesthetics', as they were called, and now suffering people could be operated on without feeling the least pain.

VIII

Operations became more and more frequent, but though the patient did not feel the surgeon's knife, he often suffered terribly afterwards. Appalling forms of blood-poisoning and septic poisoning would set up round the open wound, until the flesh actually rotted away.

Lord Lister

For years doctors could find no cure for this state of things. All they could do was to burn away the diseased

part, and fifty per cent. of the cases in hospital died in dreadful agony.

One day there came into a Glasgow hospital a slenderly built young surgeon named Lister. He had spent a most happy and comfortable boyhood, both at home and at his Quaker school. His father had been deeply interested in the development of the microscope, and young Lister was trained at an early age to observe and record with great accuracy. He determined to study medicine, and proved himself the best student of his class.

His studies finished, he went to the Glasgow hospital as house-surgeon, and here he was horrified to see the terrible condition of the wounds after operations.

He set himself the task of finding a remedy for this tragic state of affairs. First of all he examined the diseased flesh under the microscope, and found that it was not the oxygen of the air which caused the trouble, as had been supposed, but the germs which are always present in the air: these, getting to the open wound, set up decay. As it was impossible to keep all air from the wound, it was necessary to protect it from the microbes in the atmosphere.

After many experiments he found that no germs could live in carbolic acid, so he dressed

the wounds of his patients with this, and they healed splendidly.

For years he worked on this discovery until he had perfected it in every way and made it suitable for all occasions. For a time other doctors would have nothing to do with his methods, until it became known that his hospital was entirely freed from the terrible scourge of blood-poisoning and gangrene. Then young students began to flock to him for instruction, and in wonderfully clear and interesting lectures he explained his methods to them. Soon the doctors both in England and abroad began to see the value of his treatment and to adopt it generally, so that the terrible decay of the flesh round the wounds became a thing of the past.

IX

In 1867, in the disturbed and persecuted country of Poland, there was born a little girl who was to make one of the most important discoveries of modern science.

At an age when most little girls are still playing with dolls, and reading of Fairyland, little Marie was walking through a world as full of magic and mystery as any fairy-story. In her father's laboratory she soon learnt to

understand the mighty forces revealed by science, and before she was sixteen she was known as 'Miss Professor', and had earned a gold medal for her splendid work.

She became a governess in a Russian family. But the Russians made the lives of the Poles under their rule intolerable, and Marie, who loved her country dearly, joined a number of Poles who were trying to overthrow the Russian rule. Their plans were discovered, and they were obliged to flee.

Mme Curie

Marie, all alone, and disguised as an old woman, made her way from the house, and did not feel safe until she reached Paris, where she arrived with pockets almost empty.

Having taken a small back room, four flights high, up to which she had to carry her own coal, she looked about her for work. But it was hard to find, and her little stock of money was almost done before she got the poorly paid job of washing bottles and preparing furnaces at the Sorbonne, the university in Paris.

However, she soon attracted the notice of the head of the department by her keenness and her superior knowledge, and he put her to work with M. Curie.

The Professor soon fell in love with his young assistant, and she with him.

'What a grand thing it would be to unite our lives for the good of science and humanity,' he said to her, and so they were married, and continued their work together.

After immense labour and many struggles they succeeded in separating from uranium ores a substance whose power to give out penetrating rays was two million times greater than that of uranium!

Radium, as this newly discovered substance is called, has tremendous possibilities in the world of science and in the world of medicine, but it is an extremely dangerous substance to use, as the tiniest amount near the skin will cause a very bad burn.

This also is the case with X-rays—another wonderful discovery of the twentieth century, made by Professor Wilhelm Röntgen. These rays have the power of penetrating opaque substances, so that by their aid doctors are now able to take photographs of the inside of the body. Formerly they were at a great disadvantage, as they could not see the conditions

of internal organs. Now, in the case of a bullet wound, they can see where the bullet is lodged, if it is still in the body. In the case of a fractured bone, they can see the exact position of the fragments. They can watch a patient's digestion and see where it is at fault, or detect the early stages of tuberculosis.

In these and in many other ways the Röntgen or X-rays are proving extremely valuable. But they are also very destructive, and some doctors, using them, have suffered serious accidents, while in one or two cases death has resulted from the burns.

But undeterred by this danger and loss, as soldiers are undeterred by losses in their ranks, the brave experimenters go on, improving and perfecting their instruments, so that future generations may benefit by their labours.

Pasteur, Jenner, Lister, Madame Curie, and Röntgen are leaders whose campaigns in the great war against disease have been crowned with success. Hundreds of others have given their lives to the cause, and like the rank and file of the army, have passed away unknown.

But inasmuch as they worked faithfully, their work remains and is the foundation-stone on which others may build. Thinking not of

X-ray photograph of lady's gloved hand showing rings.

their own prosperity but of the benefits they could confer on mankind, they are true and noble heroes whose memory will always be honoured and revered by the suffering humanity they strove to aid.

VI

'Admiral of the Ocean Wide!'

I

YOUNG Christopher Columbus was fortunate enough to live in the beautiful old seaport of Genoa. He could wander along the quay and listen to the sailors as they talked of the far lands they had visited, or he could sit for hours gazing out over the blue waters of the bay dreaming dreams of the wide ocean, and of distant unknown lands.

Christopher Columbus.

His father was a wool spinner, hard working, but not poor; and when he saw his eldest boy was clever and studious, he determined to give him, what was not common in those days, a good education.

So young Columbus went to Pavia. There he studied geometry, geography, astronomy,

astrology, and navigation, for his dreams of the future were always dreams of the sea.

At fourteen he returned home, but not for long. He soon got work on a trading vessel, sailing along the shores of the Mediterranean and calling at many ports. Thus he learnt the art of navigating a ship, and in his spare time he continued his study of geography and astronomy, and became very clever at the drawing and engraving of maps and charts.

His mind was ever on the sea and the stars, and he cherished a secret dream of one day sailing out 'beyond the sunset'.

One of his voyages brought Columbus off the coast of Portugal. Near Lisbon the vessel took fire; he threw himself into the sea and supporting himself on an oar with one hand, and swimming with the other, he managed to reach the shore.

This accident, he thought, was quite a lucky one, for Portugal at that time was a great maritime nation, and under the influence of Henry the Navigator warmly welcomed daring sailors who would set out in search of new lands. It was a time of great excitement. The Turks had crossed the narrow Bosphorus and captured the beautiful city of Constantinople. This city had been the centre of trade and the home of learning. With the coming of the Turks the

Building a Medieval Ship, 1489. The master ship-builder gives directions to the workmen.

scholars fled with their precious manuscripts, and began to spread their learning all over Europe; but the merchants lost their warehouses, and found the gateway to the East closed to them. So they determined to find a way to the East—the home of vast wealth, costly jewels, and fragrant spices—by sea.

For forty years Prince Henry had been fitting out ships and planning voyages. His mariners had explored the coast of Africa, but none of them had yet reached the end of that coast and been able to sail eastward.

We can imagine how eagerly Columbus listened to the men who had ventured over the

unknown African seas; how he delighted in their talk of the eastern lands. He, too, had his ideas and his plans, but as yet he was an unknown foreign sailor; it was not likely that any one would supply him with a vessel until they knew more about him.

So he settled down in Lisbon, and gradually he began to be known as the maker of very accurate maps, charts, and globes. He married, had a little son, Diego, and spent some very happy years there.

But his mind was not at rest; he still dreamed of sailing on unknown seas, and as he turned his globes and dotted his charts, his imagination was seized by the immense expanse of water stretching away to the west. He had no idea how great it really was, and he was fired by the thought that perhaps, as the world was said to be round, one could reach India and the East by sailing to the West, across the wild unknown Atlantic.

After much delay he managed to interest the King in his plans, but the Council called together to discuss them would have nothing to do with them. Though people were beginning to realize that the world was not flat, as they had previously thought, they still had curious ideas about the vast unknown ocean. Every one seemed to think there would be a slope

downwards: some imagined a sudden slope, down which the sea would rush like a huge waterfall; others thought the slope would be a more gentle one—ships might be able to sail down it, but they would never be able to sail up it again on the return journey!

Columbus saw, after a time, that he could expect no help from Portugal. His wife was dead, so, taking his little son Diego by the hand, he set out for Spain, where he hoped to interest the King and Queen, Ferdinand and Isabella, in his plans.

Weary and footsore, the tall powerfully built man and the little boy of nine or ten tramped the sun-scorched roads of Andalusia. At last they came to a monastery; the monks gave them shelter and food and became much interested in them. The prior, Juan Perez, agreed to look after Diego while his father was away, and he gave Columbus letters of introduction to the Spanish court and furnished him with a mule and a guide and money for the journey.

But unfortunately for Columbus, Ferdinand and Isabella were very busy trying to drive the Moors from Spain; they had no time to think of possible lands far away across an almost impossible sea.

So again Columbus had to suffer heartbreaking delays: he was poor and almost unknown,

but he did not despair. He again earned a scanty livelihood by making globes and maps, and this trade brought him into contact with a few distinguished men, who were astonished at the grace and dignity and knowledge of the map-maker, and became his firm friends.

One of these friends at last obtained for him an audience with the King and Queen. They were kind and interested, but the Council was once more against him.

Years passed before he obtained another audience, and then he demanded the title of admiral, and the rank of viceroy over all lands he should discover. The King's councillors scornfully refused his demands, so Columbus determined to wait no longer, and mounting his mule, he set out to offer the empire of his dreams to the King of France.

Queen Isabella was distressed when she heard that the adventurer whom she admired so much had gone. She urged the King to help him, and when he again refused she exclaimed, 'Well, I will undertake the enterprise alone. I will pawn my jewels to meet the expenses.'

So a messenger was sent after the fugitive, who returned gladly to the service of Isabella. But the tiresome delays were not yet over.

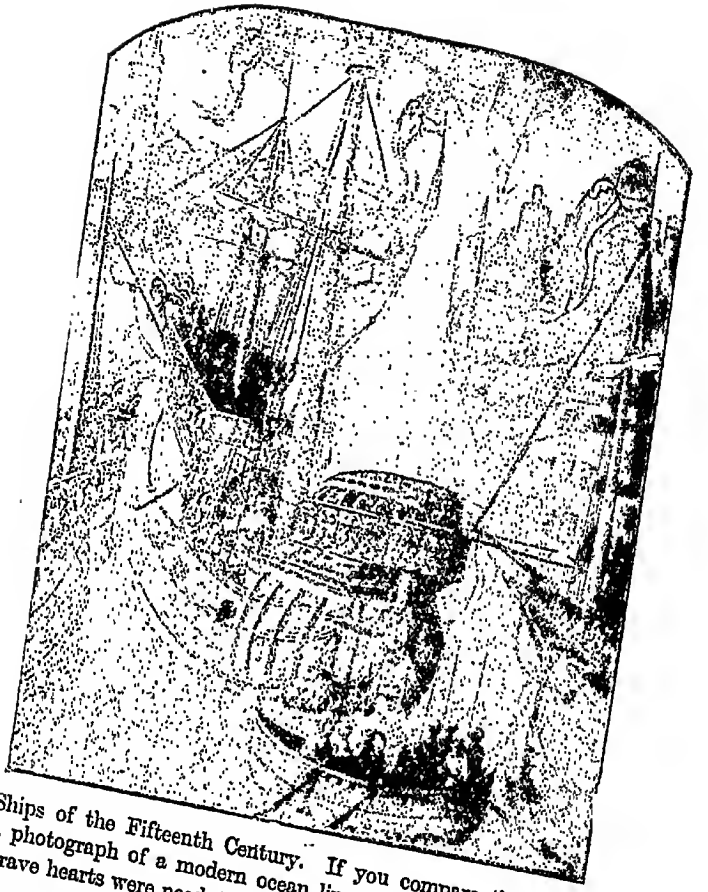
In spite of the orders of the court, owners of vessels refused to allow their ships to go to what

they considered certain destruction: seamen refused to sail on so long and so mysterious a voyage, and many of them deserted after they had enlisted.

The prior, Juan Perez, again came to the rescue, and persuaded three friends of his, wealthy mariners, to provide Columbus with ships. They were so much impressed by the faith and zeal of the adventurer that two of them decided to sail with him on his perilous voyage. At last, in August 1492, three vessels, the *Santa Maria*, the *Pinta*, and the *Nina*, were ready to put to sea.

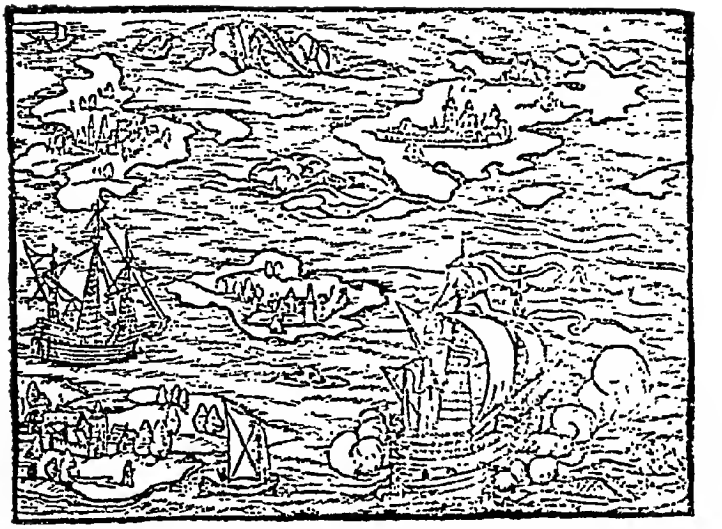
And poor little vessels they were for such a hazardous voyage—narrow little trading craft, old and weatherbeaten. Only the *Santa Maria*, on which Columbus sailed, was decked; the other two were open boats. What stout hearts and valiant courage to face the unknown leagues of ocean in such frail craft!

Before the Canary Isles were reached, the *Pinta* had a broken rudder and a leak in the hold. Three weeks were lost here while she was repaired and fresh water and provisions were taken on board. Then off again, the crew sad and despondent as they took their last look at the land of the Old World. But the Admiral called them all together and managed to inspire in them something of his own faith and energy.



Ships of the Fifteenth Century. If you compare this with a photograph of a modern ocean liner you will realize what brave hearts were needed to face the sea in such fragile craft.

The winds were favourable and carried the little fleet rapidly westward, so that for a time all went well. Soon, however, the compass, Columbus's only guide on these uncharted waters, began to behave strangely, and became, to the Admiral's dismay, quite unreliable. This



Columbus's Fleet reaching America (From a woodcut of 1494.) Look at the great sea monsters—larger than the ships—raising their heads above the water! Evidently the artist had been listening to some very exaggerated sea stories.

fact, for which Columbus could find no explanation, worried the sailors terribly, and for a time they lost heart.

Luckily, soon afterwards, some small land birds were seen, and some tufts of grass and rock plants were found floating on the water. The sailors plucked up courage, for land they felt sure could not be far away.

But their troubles were not over. They ran into a sea where the weeds were so thick that there was a danger of the ship being held fast in them. The wind dropped, and they were driven by currents which they were unable to

avoid. They saw great whales, unknown creatures, which, they feared, waited to devour them. Land, which they thought they had sighted, disappeared as they approached. Their bread and water were beginning to fail. Terror seized the men—angrily they crowded round the mast and ordered the pilots to put back—why should they all perish to satisfy the whims of one man? They would throw him into the sea—this madman who was leading them to certain death.

Coolly Columbus faced them, and quelled their mutiny by his calm courage.

Fortunately the signs of land increased and became more certain; a twig of hawthorn blossom, a carved stick, a bird's nest full of eggs, were seen floating on the waves—land could not be far away.

We can imagine with what excitement the men crowded on the masts, the yards, and the rigging in their eagerness to catch the first glimpse of the new land.

All night they watched, and as the mists of darkness were rolled away by the rising sun, there appeared before their eyes the sandy shores and green hills of a large island.

As they drew nearer they could see little huts dotted about among the trees, and groups of brown-skinned natives gazing in astonishment

at the white-winged ships that had appeared in the night.

Columbus and his men were eager to set foot on shore, but he restrained himself and them, wishing to give the act of taking possession of this new world a dignity and solemnity worthy of what was perhaps the greatest deed ever accomplished by a sailor.

Dressed in his robes of state, he entered a little boat and was rowed to the land. As soon as he stepped ashore he fell on his knees and thanked God for his mercy. Then he baptized the land with the name of Christ—San Salvador, and took possession of it in the name of the King and Queen of Spain.

Columbus called the natives—a gentle and friendly people—Indians, for he was sure he had reached an outpost of India.

II

Impatient to reach the land rich in gold and precious stones which they expected to find, the adventurers soon left the island, and sailing south reached Cuba. Here they found a most beautiful country but no gold. They next reached another large island which Columbus called Hispaniola (now San Domingo). Here, owing to the carelessness of the man at the helm, the *Santa Maria*, which had braved the

wide ocean, ran aground, and was soon a total wreck.

The natives of the Island, who were of a very fine type, were friendly and helpful. The stores and valuables from the wrecked ship were brought ashore and carefully guarded, and they allowed Columbus to build a little fort.

They gave rich presents to the Spaniards, who, when they saw their gold, at once became wild with greed. The natives were alarmed at the change, for to them gold was nothing; but when they saw how the white men almost worshipped it, they explained that they got it from a land to the South.

Columbus now thought he must be quite near the golden lands of the East, so he decided to return home with his good news, for while his men were interested in the search for wealth, he was only concerned in the discovery of the new lands which had filled his thoughts for so long.

So in the little fort the friendly natives had allowed him to build he left a few of his men, giving them instructions to explore the neighbourhood, while he, laden with gifts, set off for Europe.

The journey home was a terrible one. The vessels made little headway against the contrary winds, and as they neared the Azores they were

tossed like corks from one huge wave to another, and tremendous thunderstorms added to the terror and misery of the men. The two ships lost sight of each other, and each thought the other sunk beneath the waves.

Even Columbus lost heart, expecting every moment that his little vessel with its torn sails and broken rudder would be swamped. He had risked his life freely, but he did not wish the new knowledge which he had just gained to perish. So while the storms raged and the frightened men grew more and more threatening, Columbus sat in his little cabin and wrote out several accounts of his voyage. These he sealed up in rolls of wax or in cedar cases and cast them into the sea, hoping that they would be carried ashore and so preserve the knowledge of his discoveries.

The little *Nina* could not last another day, he was certain, but as that other day dawned there was a glad cry of 'Land Ho!' They drew near a little island, and though the Portuguese people were not friendly, Columbus managed to repair his ship a little and then set out on the last stage of his journey home.

How he must have recalled, as he cast anchor in Palos harbour, the sullen looks and the curses which had marked his departure! How different his return! The crowd, frantic with joy

and pride, rushed into the water to carry him triumphantly ashore. But the first thing that Columbus did was to walk barefooted to the monastery of his old friend Juan Perez, there to return thanks for his safe voyage and for the glory which God had allowed him to win for Spain.

'Never had any man brought to his country or to posterity such a conquest since the creation of the globe, except those who had given to the earth a new idea—and this conquest of Columbus had, until then, cost humanity neither a crime, a single life, a drop of blood, nor a tear.'

Having given thanks to God, the explorer made his way to Barcelona to lay his discoveries at the feet of his King and Queen. What a change awaited him there! The poor map-maker, who had been laughed at and scorned, was now treated with royal honours. His entry into the city, seated on a magnificent horse and attended by the nobility of Spain, was that of a prince. Ferdinand and Isabella rose to their feet to greet him and made him sit on a level with themselves. Couriers were sent to the courts of Europe to carry his news and his fame.

It was not long before Columbus sailed again for the New World, with a fleet of seventeen

vessels, and this time he had no difficulty in getting together his followers.

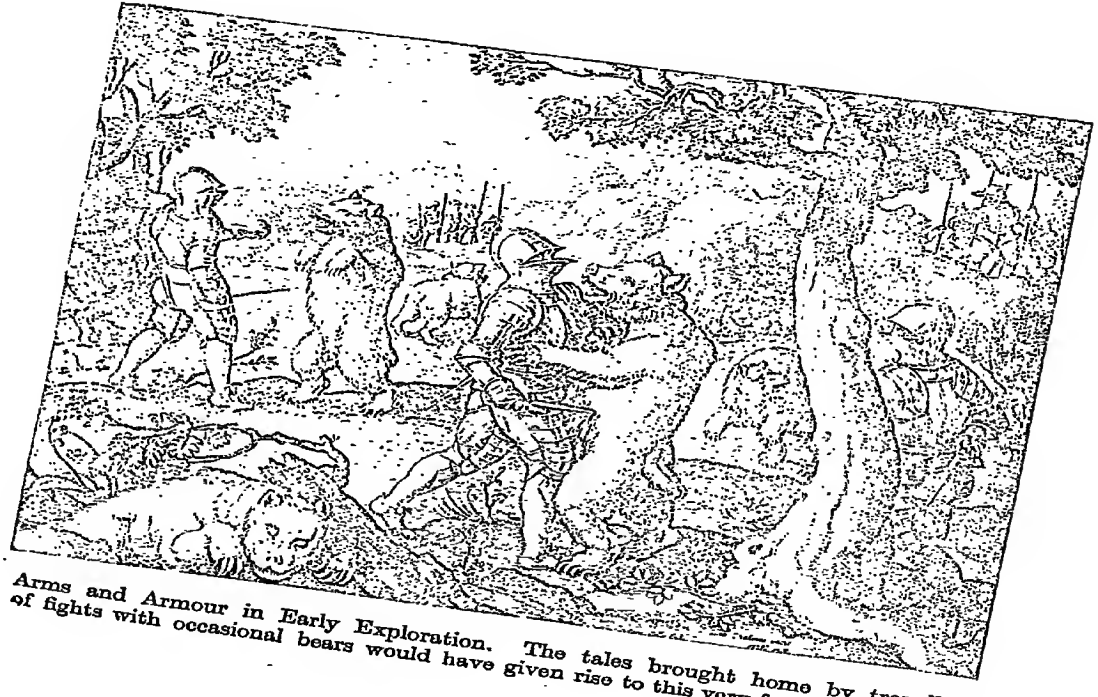
Priests and nobles, workers and labourers of all types were only too anxious to go, some wishing to spread the faith and others to gain renown or fortune in the new lands.

The voyage was a good one, but as soon as land was reached, trouble began. As the vessels approached Hispaniola, Columbus fired a salute, but no reply came back from the Spaniards he had left in the little fort.

Great was his dismay, on going ashore, to find the fort destroyed, the guns buried in the ruins, and the bones of the Spaniards bleaching in the sun.

The little native village was deserted, but the chief came to Columbus and explained how the Spaniards had treated their kindly hosts so cruelly, burning their huts and treating them like slaves, that in the end the natives had risen against them; there had been a fight and the Europeans had all been killed.

Saddened by this news Columbus sailed on and founded the town of Isabella, but he constantly had this trouble to face. Most of his followers were so greedy for gold, that they would not settle down as he wished them to do, nor would they treat the natives, who were really a very fine and peaceable race, fairly.



Arms and Armour in Early Exploration. The tales brought home by travellers of fights with occasional bears would have given rise to this very fanciful engraving.

They acted very cruelly towards them, taking shameful advantage of their kindness, and as a result there was constant trouble whenever Columbus's back was turned.

Columbus tried to make the Spaniards treat the natives decently, and as a result some of his own countrymen turned against him and sent false reports home to Spain. The explorer was ordered to return to Europe, practically as a prisoner, to give an account of himself.

After many insults and delays, the friendship of Isabella procured his release, and he was again given ships to sail to the West. He changed his course in this voyage, discovered Trinidad and landed near the mouth of the Orinoco. Thus he spent at least one night on the mainland of the continent, which, however, was not to bear his name.

He then made his way to Hispaniola, where, during his absence, affairs had become still worse between Spaniards and Indians. Again his countrymen complained of him, and again he was sent home in chains.

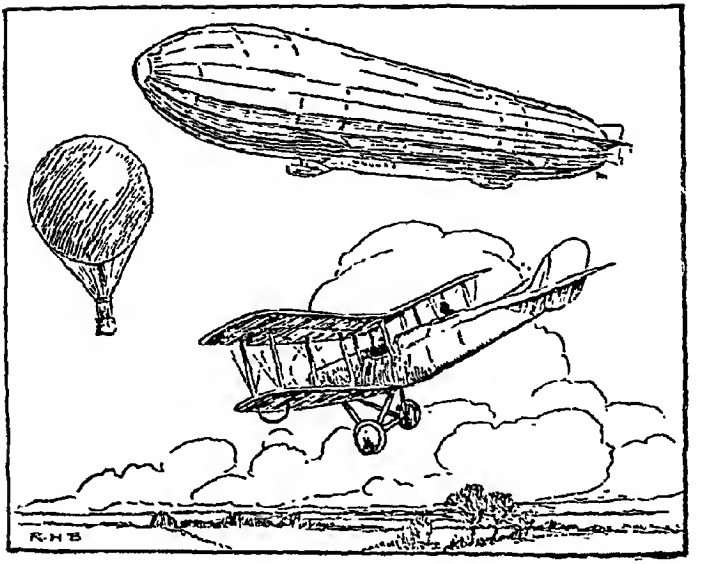
But when he arrived in Cadiz every one was indignant that this fine old man who had presented Spain with a new empire should be repaid for his service with such disgrace. Queen Isabella wept for him and restored him at once to favour.

Though an old man of nearly seventy he could not rest, and in May 1502 he set out for the fourth and last time for the New World. He made again for Hispaniola, but the governor refused to allow him to enter though a storm was brewing—refused to allow the old explorer to enter the port he himself had discovered.

He then turned to Honduras, but after more trouble with the Indians he was forced to make for Trinidad, where his vessels were wrecked on the shores of an unknown bay.

For sixteen months he remained here, sick and short of food, before the Governor of Hispaniola sent vessels to his relief. After a short stay he left the island for Europe. He arrived in Spain with his brother and his son, too ill to travel, almost too poor to pay for a lodging.

His old friend Queen Isabella lay dying: the King did not keep his promises, and the grand old man was allowed to die in loneliness and poverty. He never knew that he had discovered a new continent, but he had the satisfaction of a life nobly lived, a duty well done. Fearless, wise, cool, persistent: loving the dark-skinned peoples whom most men of his country regarded with utter contempt: forgiving his enemies, working always for the honour of God and for the welfare of his country—in short, a fine heroic soul—such was the 'Civilizer', Christopher Columbus.



VII

The Story of Flying

I

WHO would not love to fly in the air like a bird? All through the ages men have been fascinated by the idea of flying, and many attempts were made in early days to supply man with wings or some other device by means of which he could soar in the air.

Such fantastic attempts go back to the fabled days of Icarus. He and his father, Daedalus, were imprisoned by King Minos of Crete in the famous Labyrinth, which Daedalus had built

for the Minotaur. Unable to find his way out of this maze of his own devising, he had the idea of making wings of feathers and wax for himself and his son.

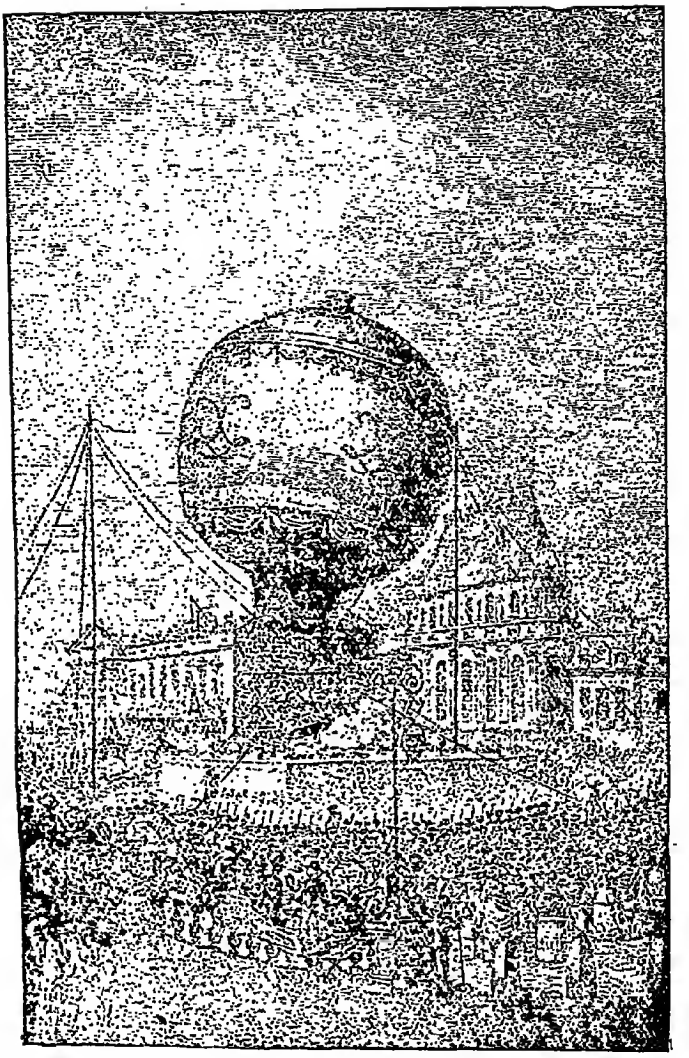
The wings completed, they soared upwards, and got safely out of the maze. Daedalus flew without mishap to the Island of Sicily; but Icarus flew too high, and the sun melted the wax of his wings, so that he fell into the sea and was drowned.

II

Many such fantastic ideas were entertained, but it was not until 1783 that the first attempt was made in a scientific way to soar into the air.

If we had been near Annonay, a town in France, in June of that year, we might have seen crowds of people making their way towards a field, in the centre of which was a heap of straw, and a kind of linen bag on a frame. Had we watched a little, we should have seen men set fire to the straw, and hold the huge bag so that the smoke blew into it.

The thing began to swell and swell, as does a paper bag when you put it to your mouth and blow hard into it. As it got full, it began to rise; men cut the ropes by which it had been moored to the ground, and lo! it rose high



Balloon ascent by Montgolfier from Versailles
19th September 1783

into the air, sailed away before the wind for about ten minutes, and dropped to earth again, a mile and a half away!

Thus was the first balloon in history sent up into the clouds, and the men to whom the credit is due for this first definite step towards travelling in the air are two French brothers, named Montgolfier.

This year, 1783, was a great one in the history of the balloon. In September the first living passengers were sent up into the air. They descended in eight minutes, having floated along for two miles. These first aeronauts were a duck, a hen, and a sheep!

Then in November of the same year, a Frenchman, named de Rozier, determined to risk everything, and himself went up in a balloon. He drifted along for twenty-five minutes! What a thrilling experience it must have been for him, as he came to land again five miles from his starting-point, to realize that he had done something no man before him had ever accomplished, and successfully floated in the air.

The Montgolfier brothers thought that it was the smoke which made their balloon rise, but soon afterwards it was discovered that it was not the smoke but the hot air from their fire which lifted the balloon.

As you know, hot air is lighter than cold air, so as soon as the linen bag was full of hot air it could rise and float on the heavier air beneath it, as a cork floats on water: the air would actually hold it up. The difficulty was to keep the air inside hot, for as soon as it became cold the balloon dropped to earth again; so a little furnace was attached at the mouth, and in this way longer journeys were made possible. But the amount of fuel that it could carry was very small, so the balloon could not be kept supplied with hot air for very long.

Was there nothing else except hot air which was lighter than the ordinary cold air?

Men set their wits to work, and by experimenting with the various gases of which the atmosphere is composed, they soon discovered that hydrogen was fourteen times lighter than air, and therefore just the thing they needed.

So hydrogen-gas balloons now took the place of hot-air balloons: improvements were constantly being made, and ascents became increasingly common. But a great drawback was that they were at the mercy of every wind; and so were not a very satisfactory means of travel.

The attempts made to steer these round balloons now seem to us very amusing. One

way that was tried was to take up oars of cloth stretched on a frame, and to try to row these great bags of gas through the air as one would row a boat on the water!

Balloons were next made cigar-shaped, and fitted with small engines and propellers which enabled them to sail against the wind, and when in 1901 Santos-Dumont steered what was then considered a huge cigar-shaped balloon round the Eiffel Tower in Paris at the rate of nineteen miles an hour, it was realized that these airships had a great future before them. Germany at once saw their possibilities for times of war, and Count Zeppelin made the improvement and perfecting of this type of aircraft his life-work, so that from this time the supremacy in the air passed from France to Germany.

Zeppelin introduced several new principles into the airships which were now called after him. Finding that the long gas-bags were inclined to 'buckle' in the middle, he made a cigar-shaped framework of aluminium, divided it into several compartments, each of which was fitted with a separate drum-shaped gas-bag, and covered the whole with varnished silk: this was the first rigid airship. By raising the cars close under the body of the balloon, and fixing the propellers to the balloon

itself, he was able to gain greater speed and facility for steering.

When the Great War came, Germany was equipped with a large number of these giant Zeppelins, with which she hoped to do great damage in France and England by dropping bombs from them on to towns, railways, etc. A few destructive raids were made, but they were not so successful as Germany had expected.

One of the great dangers which beset these airships was the danger of fire. Hydrogen, the gas which enabled them to float, was highly inflammable, and the heat from the engines might cause them to break into flames at any moment, so that the airmen could never feel very safe. It was a great day for aerial navigation when it was discovered, about 1916, that helium, a light and non-inflammable gas, which was very, very scarce, could now be manufactured very cheaply and in large quantities. So from this time onward helium was used instead of hydrogen, and the great danger of fire was practically eliminated.

After the War, in 1919, a great British dirigible, called R. 34, was built on similar lines to the Zeppelin, and this was the first airship to accomplish the great feat of crossing the Atlantic Ocean. It did the journey from Edinburgh to New York in a hundred and

eight hours; three days later it made the return trip in seventy-five hours, thus beating the fastest steamship by about two days.

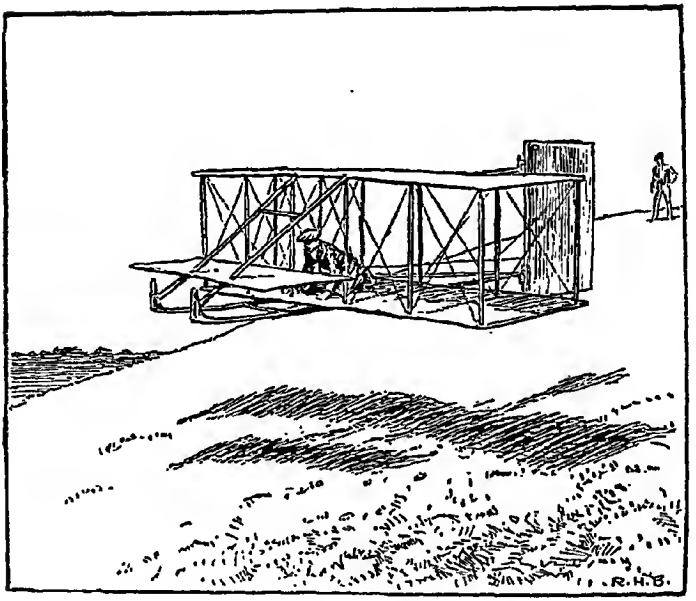
III

While men were experimenting with and perfecting these lighter-than-air craft, scientists were learning more and more about the atmosphere. Men began to ask themselves: 'How is it that large birds like the eagles, which are certainly heavier than air, can fly? If they can fly, man can fly also, if only we can discover the proper wings.'

For a long time these ideas were looked upon as quite ridiculous: 'Man can only hope to navigate the air in lighter-than-air machines,' said the scoffer.

But in America scientific attempts were being made to solve the problem. Huge box-kites were made by two brothers of the name of Wright: these were launched from hill-tops, and it was found that when they were properly balanced, and when sufficient air pressure was brought to bear underneath them, they could remain in the air for a short period.

They next improved on this kite, and built what they called a 'glider'. It had no engine, but one of the brothers just ran along by the



side of his glider, as you run with a sledge, and then, when it had gathered speed, jumped on. To the great wonder of every one, instead of crashing instantly to earth with his weight, it carried him forward for some distance and settled gradually. Man had made his first flight with wings!

But as yet he could not go very far. The next problem was to affix an engine which would force the machine through the air, and in May 1896 Professor Langley completed a machine with a small engine, which flew unattended for half a mile.

This was a great achievement, and he worked on his experiments for several years more, till at last he completed a machine which was to be driven by an engine, and to carry a man. But alas! when a great crowd had gathered to see this wonderful new thing, something went wrong with the launching gear, and the machine crashed downward and was wrecked.

People scoffed, of course, and called the machine 'Langley's Folly', but his idea was being developed by the Wright brothers, and only nine days after Langley's disaster, in December 1903, a machine driven by a petrol motor rose from the ground carrying a pilot, and flew for an hour!

What a great joy of achievement must have swelled the hearts of the brothers, the first 'birdmen' of the world: they had at last accomplished what had so long been deemed the impossible!

IV

From this time onward improvements were rapidly made: biplanes, monoplanes, seaplanes, following each other in rapid succession. Enormous strides were made during the war, one of the chief advances being in the development of an engine, very light in weight, yet

sufficiently powerful to travel at great speed for long distances.

No sooner had the war stopped than aeroplanes with great glass-covered cabins, containing most comfortable seats, were constructed, and very soon a regular service of planes was established between London and Paris, just as we have a regular service of trains and boats.

Ever anxious for further achievement, airmen next turned their attention to the long flight across the Atlantic.

Braving untold dangers which might arise from sudden storms, or from forced landings far out on the ocean, three seaplanes started from New York in May 1919 for the first long flight. N.C. 1 fell into the water and was wrecked, N.C. 3 was obliged to come down, and 'taxied' for some distance on the water to the Azores. To N.C. 4 alone remained the honour of making the whole journey. It called at Newfoundland, then flew right away to the Azores in fifteen hours and thirteen minutes. After staying there for a few days it completed the flight to Lisbon, the actual time spent in crossing the Atlantic being twenty-six hours and forty minutes.

A still greater achievement, however, was accomplished less than a month later, when Captain John Alcock and Lieutenant Arthur

Brown set off from Newfoundland, and flew the whole of the 1,960 miles without a stop, landing in Ireland sixteen hours and twelve minutes after leaving America!

Think of it! That tremendous journey across the Atlantic, which took Columbus months to make, which took the sailing vessels of sixty years ago five or six weeks, and which the floating palaces, the steam or petrol driven liners of today do in five days, can now be accomplished in the air in the short space of sixteen hours! Surely the age of wonders and miracles is not passed!

Since 1919 several great and marvellous flights have been accomplished both by airships and aeroplanes: men have flown across the uncharted deserts of Africa, and have rivalled Drake in the circumnavigation of the world. The journey from England to New Zealand, which takes the fastest steamer six weeks to accomplish, can now be done by aircraft in nine days! And improvements are constantly being made.

Time and distance are conquered, and man's ingenuity, perseverance, and skill are linking up the most distant places of the earth, and making possible the brotherhood of all mankind.

VIII

Everest, Conquered or Not Conquered?

EVEREST, as you know, is the highest mountain in the world; it stands 29,002 feet above sea-level, in the Himalayas. 'Goddess Mother of Snows' the Tibetans call it; to them it is a goddess indeed, and to climb her will anger her by surprising her secrets.

Yet in spite of this, people have always been very keen on reaching the highest points in the world, on the summit of Everest, partly for scientific reasons, and partly from sheer love of adventure and of overcoming difficulties. In 1914 Brigadier-General the Hon. C. G. Bruce organized an expedition to climb the mountain, but the outbreak of the Great War made it impossible for him to carry out his plans. Then, in 1921, Colonel Howard Bury explored its lower slopes, and in the following year General Bruce made a definite attempt on the summit—but in vain. Again he tried, in 1924, but the expedition was once more ill-fated; he himself had to retire owing to bad health, and two of his best climbers, Mallory and Irvine, were killed.

Mount Everest
A beautiful but terrifying picture of the tremendous precipices and fields of ice.

The death of these two fine men remains something of a mystery. Did they actually conquer Everest? There are people who believe that they did. They were watched through field-glasses climbing very high up, quite near the huge rounded snowfield that forms the topmost hump of the mountain. Then mist descended, followed by a blizzard, and they were never seen again. There seems, however, a good deal of doubt whether they did reach the summit; more likely they were overtaken by the blizzard while still on their upward journey or suffocated through lack of oxygen: defects in the oxygen apparatus, which every climber on Everest has to carry to enable him to breathe, had been noticed earlier in the work of the expedition. Perhaps both things happened. But there is not the slightest doubt that, however they perished, they gave their lives gallantly.

When another expedition was formed in 1933 under the leadership of Mr. Hugh Ruttledge, some of its members had the mournful pleasure of finding, on one of the highest slopes up which the two are known to have toiled, an old ice-axe. To whom had it belonged—to Mallory or to Irvine? This we shall never know; yet it had certainly belonged to one or the other, for only one party—that which had

been led by Lt.-Col. Norton in 1924—had ever climbed higher, and no axe had been lost by any member of it.

The 1933 expedition succeeded in reaching a height of 28,100 feet—about a thousand feet from the summit, and no higher than Norton. But they were dogged by ill luck. During their long journey across Tibet the weather was bad and it continued so throughout their assault on the mountain; it was, indeed, the breaking of the monsoon and the falling of fifteen feet of new snow that finally compelled them to give up all hope of success. Violent storms and blizzards, always frequent on the upper slopes of Everest, were that year more violent than usual, and seriously reduced the number of days upon which climbing was possible. And the extra hardships which such weather forced upon the climbers, combined with keen disappointment at having failed, helped to exhaust them and to break their health. Most of them were severely frost-bitten—one of the Europeans had to be carried down to the Base Camp, and several of the porters lost fingers. Another European was seriously ill with an internal complaint. All suffered from enlarged, and therefore weakened, hearts, due to exposure and the necessity of breathing rarefied air for long periods.

Mallory and Norton Climbing on Mount Everest
Climbing at high altitudes is so tremendous a strain that lifting one's foot seems a great undertaking, and there must be long pauses between the steps.

It is difficult for us who live ordinary 'civilized' lives to realize the risks to health which climbers run at great heights. Even with better weather, the members of the 1924 expedition had suffered from several of the ailments which befell their successors; in addition, one

of them had been afflicted with what is known as 'high altitude throat'—that is to say, a throat so parched that it is not merely an inconvenience but possibly an actual danger. And Lt.-Col. Norton had become so blinded by the dazzling whiteness of the snow that he completely lost his sight for some days, and had to be led, helpless and in great pain, down the perilous mountain-side by his companions.

Nevertheless, the expedition of 1933 was noteworthy for two things: first for the use of wireless telegraphy, which kept it in touch with the outer world and enabled it to receive weather forecasts, and secondly for a heroic attempt by Mr. Frank Smythe to reach the summit alone. He started out with another member, Shipton, from Camp Six, which had been pitched at a height of 27,400 feet, and where he met two other climbers of the party who had been forced to descend owing to bad weather.

'We spent the night there,' he says, 'but next day, owing to a blizzard, we were unable to start, so had to spend another night, making two of the most uncomfortable nights of our lives. But the following morning we were able to start upon the bid for the summit. An hour or two after we had left Camp Six, Shipton succumbed to some internal trouble and was

unable to proceed. He returned to the Camp and I continued alone.

'The blizzard of the previous day had destroyed all hope of reaching the summit. The steep slabs were covered deeply in snow and progress was impossible. I reached the same point (28,100 feet) as did Wyn Harris and Wager [the two he had met descending] and then returned to Camp Six. Shipton went down from there, and once more the weather broke badly and he had a terrible struggle in a storm which nearly cost him his life, but somehow managed to get down to Camp Five (25,650 feet), where Birnie was in support. I spent another night at Camp Six, wondering whether the tent with me inside it was going to be blown away by the hurricane.

'The next morning I descended to Camp Four (23,000 feet). On the way down I was caught in another of those sudden storms, and had it not been possible to shelter (and I was almost completely frozen and exhausted) I should not have got down. The force of the wind was so great that several times I was blown clean off hand- and foot-holds and reduced to crawling on hands and knees in the blinding drift.'

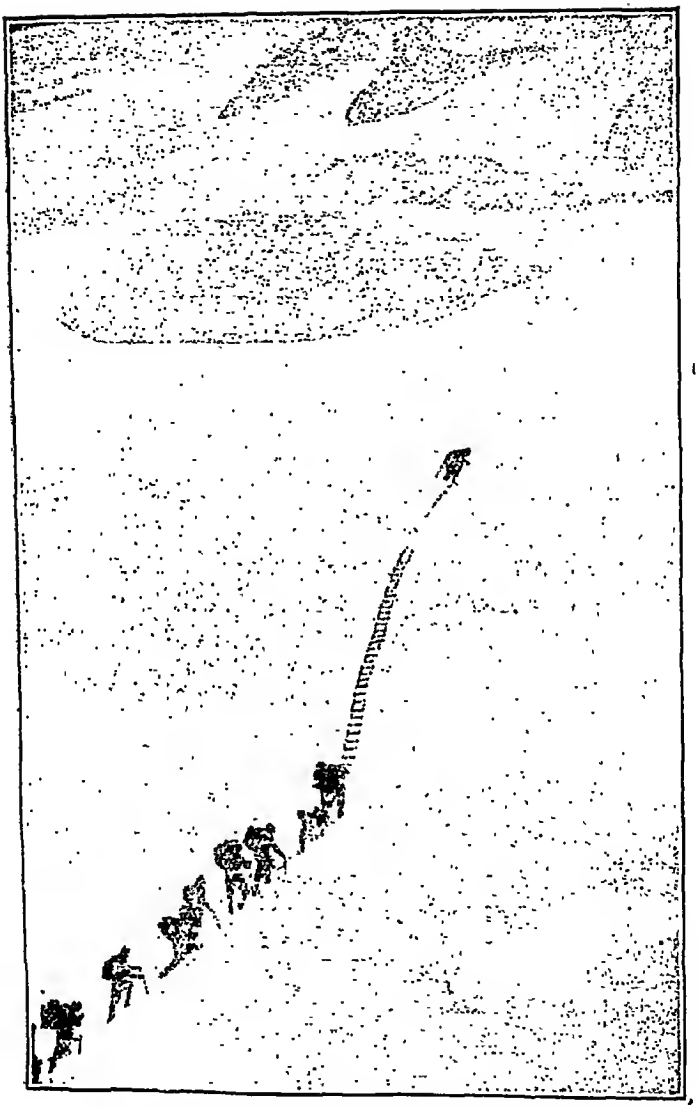
And so Everest, 'Goddess Mother of Snows' —Peak XV as she used to be called on the old

Ordnance Survey maps—remained still unconquered.

But did she ?

The year 1933 saw also an expedition to Everest of a different kind—an expedition not to climb her, but to fly over her and thus to obtain photographs which should make her geography clear and enable map-makers to fill in those spaces which had still to be left blank owing to lack of detailed knowledge. This expedition, which was led by Air-Commodore Fellowes, proved triumphantly successful; so that, although the summit of Everest has never yet been trodden by the foot of man, it has been looked down upon from above by a man in an aeroplane. Whether this should really be called conquest or not is a matter which you had better decide for yourself.

You know that climbers on Everest have to carry with them a supply of oxygen (which is the part of the air that supports life) in order to be able to breathe at all at so great a height. It is obvious, therefore, that the flyers had to carry it too; they breathed it through a mouthpiece fitted to their clothing and leading by a tube to a cylinder of the compressed gas on the floor of the aeroplane. Moreover, the cockpit was enclosed, partly to provide a shelter against the rush of air, which would



Tackling one of Mount Everest's Ice Walls.
By means of a rope ladder—one man, having cut steps in the ice, climbs up to drop it down—the party, consisting of well-laden porters, hauls itself higher and higher.

have blown any oxygen escaping from the mouthpiece right away from the pilot and the photographer, and partly to shut out the terrible cold, which might easily have frozen the oxygen solid before it reached the airmen at all. Had they been deprived of it, they must have lost consciousness in little more than half a minute.

In spite of the difficulties of breathing, climbers can encourage some sort of warmth in their bodies by the exercise that climbing gives them; airmen in an aeroplane have no such chance of keeping themselves from freezing to death. Everything they wore, therefore, had to be warmed by an electric current passing through it along special wires connected to a dynamo in the engine. All their clothes and flying suits were warmed in this manner, their gloves and helmets and boots—even their goggles, in which tiny filaments were cleverly inserted between two thin sheets of triplex glass.

No less important was the warming of the cameras with which the photographs of Everest were to be taken. Most of them were film cameras, and celluloid film when frozen becomes so brittle that it flies to pieces at a touch. But on the other hand, some care had to be exercised to prevent the film from getting too hot—for celluloid is terribly inflammable,

as many people have discovered at the cost of horrible injuries. Every camera was provided with either internal heating elements or a padded fabric jacket with heating wires sewn into it; the spare magazines of films, the spare parts of the cameras themselves, and various tools that might be required in connexion with them, were similarly heated.

Electricity for all these purposes was generated in the engine by means of a specially designed dynamo; but to prevent the effects that would inevitably be felt were this mechanism to break down, a number of accumulators were carried, themselves swathed in felt and padding. Since every filament used for heating had, of course, to be connected to the main electrical supply, the cockpit was a wonderful tangle of wires, and special trial flights had to be made, just to get the pilot and photographer used to working in such complicated conditions. Fortunately nobody was electrocuted!

As many preparations as possible were made in England, but some had, naturally, to be left until the last minute, in India. Climbing expeditions had all attempted the mountain from the north side, by way of Tibet; the south side is thought to be unclimbable. But Tibet is a conservative and jealously guarded country, and an aeroplane would not have been allowed

inside it; whereas the Maharajah of Nepal, whose dominions extend to the south side of Everest, welcomed the fliers gladly. Purnea, about 150 miles from the mountain, was therefore chosen as the expedition's base, where the aeroplanes were housed, stores kept, and all final arrangements made.

Among the things that the expedition had to discover before any flight could be undertaken with reasonable chance of success was the exact speed of the wind over the mountain. The terrible and sudden hurricanes near its summit were well known, and in almost every sort of weather a plume of flying snow and ice particles, like white smoke from a smouldering volcano, trailed down-wind from its pinnacle. Was this wind always strong enough to make flying perilous or even out of the question?

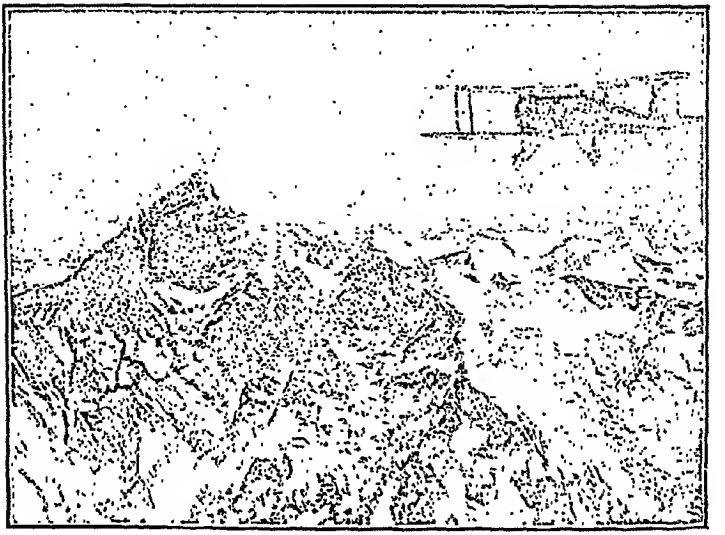
Sometimes it seemed to die down altogether; but then clouds would mass themselves about the mountain, rendering photography impossible—and without photographs, from which maps could afterwards be made, the whole expedition would be useless. When the weather was clear for photography the wind usually rose to a speed of at least seventy miles an hour. Such high winds as this would, of course, cause the aeroplane to drift very far out of its straight course, and so lengthen the journey it would

have to make from Purnea to the summit and back. Besides, what with cameras, men, and oxygen apparatus, the plane already carried a heavy load, and at such heights, what is known as the 'lift' of the plane—that is, its power to rise from and keep above the ground—is much less than when nearer sea-level. Therefore a lot more petrol would need to be expended to keep the plane in the air. Would the biggest petrol supply the plane could carry be sufficient to meet the decreased lift over a stretch made longer by drift?

Yes, decided the chief men of the expedition. But in order to make the risk of failure as small as possible, they must wait for the weather that was so rare—a still day clear for photography. Waiting for it proved a trying experience; at last it arrived—on the 3rd of April 1933. The two planes were brought from their hangars, pilots and photographers made their final preparations, and early in the morning the exciting flight was begun.

It was uneventful until Everest was almost reached and Lt.-Col. Blacker, the photographer in the first plane, had begun to take his pictures.

'Suddenly,' he says, 'as I was occupied with recharging my cameras, I felt the aeroplane sink rapidly beneath my feet. A glance



Flying Over the Roof of the World
One of the planes of the Houston Mount Everest expedition photographed through the struts of the other.

at the altimeter showed that we had lost a good many hundred feet in a few seconds.'

They had come above some of the tremendous cliffs and chasms that make up the mighty bulk of Everest, and had been caught in one of the huge down-draughts that airmen experience over broken country. Lt.-Col. Blacker continues:

'I stood up and looked out to see Everest itself, so immense in front of us that it seemed that we could scarcely clear the summit. But up and up our great engine took us, and then

the amazing immaculate crest flashed past below us. I looked down through the open floor and saw what no man since time began had ever seen before. No words can tell the awfulness of that vision. Entranced by both thought and sight, I was spellbound for a moment.'

As a matter of fact, the plane had cleared the summit by a bare hundred feet! Again Lt.-Col. Blacker goes on:

'But immediately another great vortex or overfall of winds seized the machine, which swooped down 1,500 or perhaps 2,000 feet in a second or two.

'The pilot [Lord Clydesdale] turned her at once into the wind, her nose to the westward, and for some little time we battled against wind and downfall combined, so that for all our 120 miles of speed we scarcely made headway. But our splendid engine bore us up, through and over everything, and soon we were back over the vast untrodden glacier south of the ranges. As we came round over the topmost peak we passed through the famous plume of the mountain, that awesome miles-long white streamer which men see and marvel at 200 miles away. Huge flakes of ice rattled into the cockpit with such force as to break one of its windows.

'The pilot, handling the machine with consummate skill, turned her round in big curves, so that I could take a rapid succession of oblique pictures of those stupendous ice cliffs.'

On their safe return to Purnea, however, it was found that some of the pictures had failed in their object, and that no map-maker could have worked from them. A second flight therefore became necessary, and was made about a fortnight later—in a wind over the summit of 110 miles an hour!

Luckily the pilot was able to manœuvre the machine so that this hurricane was slightly in his favour instead of preventing him from keeping in the air at all. Meanwhile Lt.-Col. Blacker was hard at work at his photography, 'panting for breath and racking my lungs to keep them filled with oxygen. Every few seconds I was forced to get down to the cockpit floor to supervise the fixed camera [which worked automatically]. In between, I had to spring up, reload, uncap the slide, set the shutter, select an object, steady the camera against engine vibration, and release the lever. Then, quickly, the slide had to be covered again and placed carefully in the cunningly devised slide box with its spring lid. . . .

'We came once more close to Everest, which had lost none of its majesty and entrancing

beauty. The machine circled serenely, as if the hurricane blast to which the six-mile-long plume from Everest summit bore witness, were a calm. I photographed incessantly, striving to remember the gaps of the first flight and to make them good for science.'

The Top of the World!
A photograph taken looking *down* upon the summit of Mount Everest.

He succeeded. It is early as yet to say how much the expedition has given to our knowledge of the mountain that is called the roof of the world. But it is surely a great deal.

IX

The Amazing Experiments of Sir Jagadis Bose

As long ago as 1879 a well-known French scientist published a book in which he pointed out that the life of plants has much in common with that of animals. At night, for instance, a green-leaved plant takes in oxygen and gives out carbon dioxide exactly in the same way as you or I or a dog. In fact, the plant breathes.

Again, a plant has digestive processes which change starch into sugar, and it forms certain waste products, though these it seems able to use up again. Plants have no muscles, yet they have considerable powers of movement. Blossoms turn their open faces toward the sun or lower their heads when rain falls, the tips of twigs are in constant movement, while some plants, such as the mimosa, have very special movements. The mimosa shrinks away from the human hand before it is actually touched, and when touched collapses like a closed umbrella and for the time shams dead.

But it was not until the present century that there appeared a scientist who began a deep study of these phenomena and made the startling discovery that *plants have hearts*. This was Sir Jagadis Chandra Bose, the first Indian scientist to attain a world-wide reputation, and also the first to be knighted for scientific work.

Sir Jagadis Bose is of small stature and is now no longer young, yet one who has heard him lecture says of him that his expression 'exhales a spirit of sheer beauty, especially when he talks'. In 1900 Bose received a second invitation to present his results to scientific associations in Europe. While in London he took advantage of the offer made to him, through Sir James Dewar and Lord Rayleigh, to work in the Davy-Faraday Laboratory of the Royal Institution. He worked there to such purpose that even the popular newspapers and magazines recorded the wonders he achieved. Then he came back to India, where he has toiled alone for more than twenty years. Disturbingly alone, for among India's three hundred millions he has been the only man working on these special lines.

In 1926 he returned to England, lecturing before the British Association at Oxford, where the great Einstein himself was in the audience. When the lecture was over Einstein solemnly declared that Bose ought to have a statue erected

in his honour in the capital of the League of Nations.

And why was Einstein so impressed? Why is it that Bose's name is now known, not merely in the laboratories, but all over the world? It is because he has proved that all life is one. By actual experiment he has shown that steel and other metals can feel, that plants have emotions, and that everything created lives and dies.

Bose has not done this merely by watching plants through a magnifying glass. He has invented whole sets of delicate instruments for measuring the sensations of plants. He has been called a mystic, but he is a mystic who measures his visions to the millionth of an inch. He may have the imagination of the East, but to this he adds the cold precision of the Western man of science.

Yet his discoveries are so marvellous that it is difficult to believe them. They seem to be far more like fairy tales than records of scientific fact. Listen to what he says himself

> Hitherto we have regarded trees and plants as not akin to us because they are the voiceless of the world, but I will show you that they are sensible creatures in that they really exist and can answer your questions. When it receives a shock the leaf of this mimosa drops, and we have invented an apparatus by means of which this answer can be made intelligible.

Sir Jagadis Bose [*Photo by Elliott & Fry*

Our hearing ranges through no fewer than eleven octaves, but our sight through only one octave of light. Anything that does not range between red and violet we cannot see. Yet the plant actually sees the ultra-violet and even those ether waves which bring to us wireless concerts.

It is not unlikely that plants have a sixth sense. In certain of my experiments I have noticed—I say it with caution, because I do not want to appear to magnify the truth; that truth exists and we intend to find it—that while a plant was recording a throbbing the pulsing was affected by the approach of certain people, but became normal again when they went away. Generally a plant took twelve minutes to recover from the blow.

The instruments invented by Sir Jagadis for the purpose of measuring the pulses of plants are amazingly delicate. The movements of a plant are so slow that even the sluggish progress of a snail is six thousand times faster than the growth of a plant, whose average rate is one-millionth part of an inch per second. One inch in a million seconds—that is the *average* growth, but some plants, such as the bamboo, grow much more rapidly. A bamboo shoot grows from nine to twelve inches in twenty-four hours.

Sir Jagadis first tried to solve the problem by the invention of a machine which he called the crescograph (growth-recording machine), and some idea of its power may be gathered from the fact that if attached to a snail it would show

this slowest of creatures as shooting forward at the rate of two hundred million feet an hour. Sir Jagadis says

> Plants have hearts. Long before I invented the crescograph I was already certain that sap-pressure rising in the stem worked in almost exactly the same way as blood driven by the human heart. In other words the pressure was not constant, but came in beats. The crescograph gave definite proof that every surmise was correct. The actual rate of the pulsation of sap in a cyclamen (a kind of plant) proved to be the one-hundred-thousandth part of an inch per second.

Another method employed by the great scientist was one in which he pushed an electrical probe against the stem of the plant, shifting the probe forward by one-tenth of a millimetre at a time until the galvanometer began to record. His aim was to keep the stem stationary, allowing the rod to touch the stem with just the right pressure, so that each heart-beat could be discovered. The great difficulty was to find the right kind of rod; many things were tried, but proved useless. One day Sir Jagadis was at the Zoo, and happened to pick up the quill of a hedgehog. In a flash he realized that this was an ideal rod, as indeed it proved to be.

Another problem was to keep the very delicate instrument from being affected by the shaking

caused by lorries and other heavy vehicles passing over the road outside the house. Complicated shock-absorbers had to be devised and constructed before this object was attained.

The Bose Institute is near Calcutta; there is a lecture theatre and a laboratory surrounded by a charming garden. Around the garden are the quarters of European and Indian students. Not so much as a screw comes from outside. Everything for the delicate instruments is made there in the workshops. There is plenty of money available, for although Sir Jagadis has troubled little about patent rights of his inventions, he has done so many marvellous things that he has made a large fortune—how large may be gathered from the fact that he has endowed his institute with about fourteen lacs of rupees; and although he lives like a hermit and gives away almost all his income, yet fresh sums are always coming in from all parts of the world.

His instruments are so marvellously delicate that he has been able to prove that plants respond to wireless stimulation which is beyond the limit of human perception. Here is an instance of his methods. He takes a mimosa (the sensitive plant already mentioned) and brings this up under glass, screened from all shock and discomfort. To all appearance it

flourishes and grows fat, yet when tested it proves sluggish. It no longer responds, like its wild brother, to stimulation. A graph of its slow movements is taken; these provide a startling contrast to the complete collapse of the wild mimosa.

Then Sir Jagadis poisons a plant, placing the stem in bromide, and the plant is made to record the throbbing due to the action of the poison. The result suggests the flutterings of a living creature struggling for life.

Thousands of years ago Indian doctors discovered that a very small amount of the poison from the fangs of a cobra administered in the form of a solution had the effect of reviving dying patients. This explains why it has been the custom to take the body of an Indian who has died from cobra bite and to place it on a raft and send it downstream, the idea being that he may later wake up. Sir Jagadis has discovered that this solution of cobra poison will quicken the heart-beats of a plant.

The human tongue is very sensitive to electric currents, and in this respect an Indian is on an average twice as sensitive as a European. It has been found by experiment that different individuals and different races vary enormously in their response to such influences as electric currents, as also in their response to changes of

temperature, of pressure, and of light. Some people can hear the high-pitched squeak of the bat, others cannot; some are intensely sensitive to draughts, others get a headache before a thunderstorm. The ant perceives the rays beyond the violet which are invisible to man, and many birds seem to have a magnetic sense which guides them on long flights out of sight of land.

In the same way plants are found to vary greatly in their powers of perception. Sir Jagadis has shown, for instance, that a tree can notice the passing of a cloud between itself and the sun. With his delicate instruments he has proved that it reacts—you might almost say 'shivers'. And plants are far more sensitive to electric currents than man.

On the other hand, plants are slower in their response to such influences. In man or other animals there is an appreciable time between the spur and the reaction. If you prick your foot with a needle the message of pain has to be flashed from the foot to the brain and back by means of a chain of nerves. In a frog this interval is about one-hundredth of a second, but in a plant it is fifty to seventy-five times as long, and the interval is longer in cold weather than in warm. It is also lengthened by fatigue. In other words, if you try the same experiment

several times on the same plant the plant gets tired. Sir Jagadis considers that the line of cells along which the impulse passes in a plant resembles the human nerves, and that the plant begins to show traces of mind.

There is a practical result from all this work, for Sir Jagadis has discovered a large number of plants which have medicinal properties, the existence of which had never before been suspected. Some of these are especially useful in cases of failing heart action.

Sir Jagadis has done much more than enlarge our knowledge of plants. He has worked on metals and discovered that they too have the vital force. Metal-workers have known for a long time past that metals can suffer from fatigue. For that matter, every man who owns razors knows that it is not good to use the same blade day after day. A razor in daily use gets duller and duller, even if stropped afresh at each time of using; but if it be laid aside for a few days it will recover its keen edge. The X-ray has demonstrated that rest causes the disturbed molecules to fall back into their original positions.

Sir Jagadis uses the galvanometer to test the fatigue of metals. The galvanometer is a delicate instrument used for detecting the presence of electric currents. It contains a

needle on a pivot, and this needle is deflected by even the faintest of currents. Diagrams from galvanometer tests show that metal resembles muscle in that its sensitiveness grows less and less under repeated shocks.

But Sir Jagadis has gone farther than this. We all know the effect of great cold on our own bodies, which grow numb. If your hand is half-frozen you may cut it badly without feeling the pain. Then as regards animals, creatures such as hedgehogs lie all the winter in a sleep that resembles death. Sir Jagadis has proved that metals, like animals, are most sensitive at temperatures characteristic of summer, while in frost or in great heat their sensitiveness rapidly diminishes. More wonderful still, he has shown that metals are affected by stimulants and by drugs. A dose of bromide puts the human brain to sleep and a dose of bromide of potassium administered to a block of tin makes it lose much of its normal sensitiveness.

The parallel between man and metals has been carried even farther. A large dose of opium deadens all the human senses, but a small dose makes them more active. Metals react in a similar way.

More marvellous still, metals can be killed by poison, like animals. A piece of metal in a healthy condition was taken and tested; the

galvanometer showed that it was in full vigour. Then it was treated with a dose of oxalic acid, a strong poison. At once there was a sudden flutter, then the galvanometer signals grew more and more feeble, until they almost ceased. A powerful antidote was applied, and slowly the metal began to recover and to record again. The metal was given a rest, and soon recovered its normal activity.

Then the experiment was carried out a second time, the metal being kept in the bath of poison until the signals ceased altogether. The metal was then taken out and the antidote applied. It was too late. The metal had been killed. Sir Jagadis varied the experiment by using other metals, but in each case the result was the same.

This is a very strange thing, for apparently, of course, the poison affects only the outside of the metal, by rusting it. Yet actually the entire structure of the metal is affected. It appears that the metals we use in our knives, pens, motor-cars, and so forth are dead, or at least in a state of unnatural heavy sleep caused by the enormous temperatures and the hammering which they have suffered. But the foregoing experiments make it conceivable that in future we may make use of live metals in ways as yet untried.

Sir Jagadis ranks as one of the most original of scientific explorers, for he is the first to prove that the three kingdoms of matter—the animal, the vegetable, and the mineral—are one in essence, and that the distinction previously drawn between organic and inorganic matter is based on a false assumption.

A

Motors for Every One

JUST over seventy years ago there was born on a farm in Michigan, one of the United States of America, a boy who, when he became a man, was to do more than any one else to make motor-cars cheap and to bring them within reach of average people. His name was Henry Ford, and today you will see Ford cars in all parts of the world.

Henry Ford

Henry's parents were farmers, and even when he was quite small he used to think how much more easily and quickly the work of a farm could be performed if it were carried on by machines instead of by men and animals. And he longed even then to invent machines that would plough and sow and reap, and thus make the work done by the men less hard and the hours less long, so that they could have either more leisure or time to do other work.

Then one day he met what used to be called a road-engine—that is, a steam-engine that would travel along a road from one farm to another and, certain simple changes in its mechanism having been made, drive machinery on the various farms. Very few such engines were in use at that time, and Henry, who was in a cart with his father when it came along, was out of the cart and talking to the engineer in charge before his father realized what had happened. And in a very short time Henry knew all about that engine. He also knew what was wrong with it—that it was much too heavy and clumsy and therefore cost too much to run. But before starting to think about improvements, he tried to make a working model, to assure himself that he really and thoroughly understood it.

You see, Henry was a born mechanic. 'I had,' he tells us, 'a kind of workshop with odds and ends of metal for tools before I had anything else. In those days we did not have the toys of today; what we had were home-made. My toys were all tools—they still are! And every fragment of machinery was a treasure.'

For a long time his models of the road-engine met with no success; some years later, however, 'I did make one that ran very well, but from the time I saw that road-engine as a boy of twelve right forward to today, my great interest

has been in making a machine that would travel the roads. Driving to town, I always had a pocket full of trinkets—nuts, washers, and odds and ends of machinery. Often I took a broken watch and tried to put it together. When I was thirteen I managed for the first time to put a watch together so that it would keep time. By the time I was fifteen I could do almost anything in watch-repairing—although my tools were of the crudest. There is an immense amount to be learned simply by tinkering with things. It is not possible to learn from books how everything is made—and a real mechanic ought to know how nearly everything is made.'

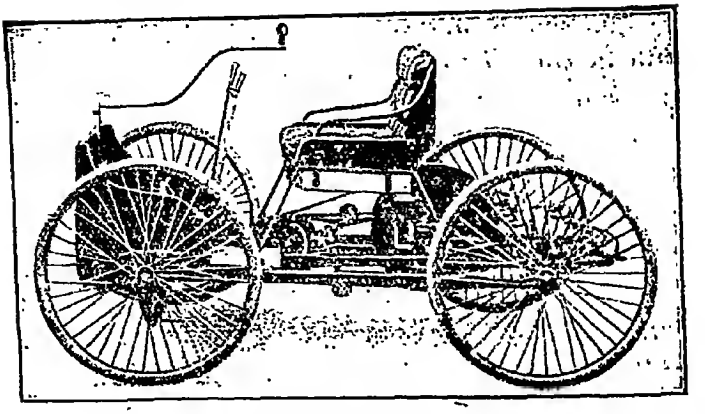
His father, of course, took it for granted that Henry, like himself, was going to devote his life to looking after the farm. But no; Henry was determined to make all the use he could of his mechanical ability, and, after rather a hard tussle with his father, he was sent as an apprentice to an engine works in the city of Detroit. There he learned the one thing he had been sent to learn—his job; learned it completely and thoroughly, and loved it. But all the time his mind was busy too with the problem of making some sort of road-engine or other machine that should be light in weight, strong in build, cheap to run, and cheap to buy. He could see no reason why some such machine should not

be popular with farmers for their work, or, in a different form, should not be used to take passengers about from one place to another.

So far, however, it had not occurred to him to use petrol as his power for the engine—all his experiments had been made with steam. Though there were railways in those days, of course, no one had ever thought of petrol-driven motors such as we know today. 'Horseless carriages' driven by steam had been made more than fifty years previously, rather as curiosities than for use, and in England there were large steam-engines that hauled lines of trailers along the roads. Then, from an English magazine, young Ford learned of an engine, run by gas, that had recently been invented. His quick mind saw the possibilities in this new invention, which developed into the petrol engine—the father, as it were, of the modern motor.

Little by little he mastered the details of this new form of engine, built one for himself as an experiment, and at last—in 1892, when he was twenty-nine years old—succeeded in building his first motor.

But what a comic affair we should think it today! It looked simply like a horse-carriage without horses—except that the wheels were bicycle wheels with rubber tyres. The seat (it held two persons) was slung on four posts in



The First Ford Car
Only a very few years ago, nobody saw anything to smile at in this queer-looking machine.

the middle of the carriage, and in place of the steering wheel was a rod like a ship's tiller. Yet it would travel at the then amazing speed of twenty miles an hour, easily passing all the road-engines, and finding nothing to beat it.

'It was considered,' says Ford, 'to be something of a nuisance, for it made a racket and it scared horses. Also it blocked traffic. For if I stopped my machine anywhere in town a crowd was around it before I could start up again. If I left it alone even for a minute some inquisitive person always tried to run it. Finally, I had to carry a chain and chain it to a lamp-post whenever I left it anywhere. And then there was trouble with the police.'

'You see, it was the first motor that had ever run in the city of Detroit, and the novelty did not soon wear off. Ford sold it after keeping it in use for three years. By that time, however, he had learned a lot both about his own car and also, and perhaps more usefully, about cars that were being built in other countries. All this work had been done, so far, in his spare time; but about 1896 he set up in business for himself, and because people felt that the great test of a motor was its speed, he soon entered for a race, with a car that he had specially built, called the '999'. At first he could get nobody to drive it—every one he approached said it was too dangerous; but at last there came along a man named Oldfield, who had never driven a car before.

'It took us only a week to teach him how to drive. The man did not know what fear was. All that he had to learn was how to control the monster. Controlling the fastest car of today was nothing as compared to controlling that car. The steering-wheel had not yet been thought of. All the previous cars that I had built simply had tillers. On this one I put a two-handed tiller, for holding the car in line required all the strength of a strong man. . . . The tracks then were not scientifically banked. It was not known how much speed a motor-car could

develop. No one knew better than Oldfield what the turns meant, and as he took his seat, while I was cranking the car for the start, he remarked cheerily: 'Well, this chariot may kill me, but they will say afterward that I was going like blazes when she took me over the bank.'

'And he did go. . . . He never dared to look round. He did not shut off on the curves. He simply let that car go—and go it did. He was about half a mile ahead of the next man at the end of the race!'

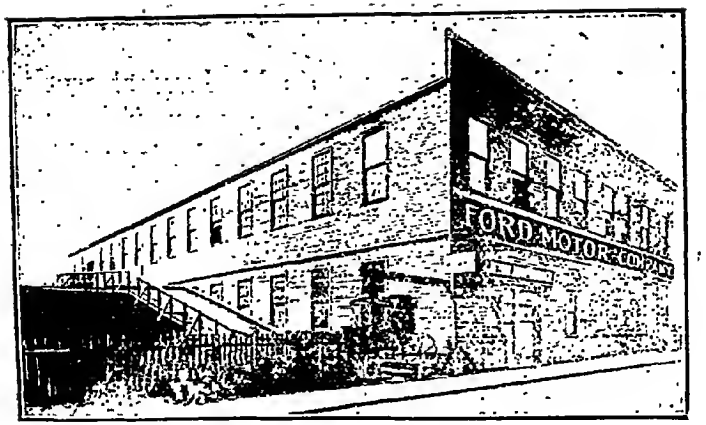
For building his cars at that time Ford was using a little shop in a small street; but as he became better known he erected a big factory, which has by now become so big that he employs thousands of men there to turn out hundreds of cars every day. He has, indeed, factories big and small all over the United States—and in England, and on the continent of Europe, and in Australia too: and the total number of people who work for him runs not into thousands, but into scores of thousands.

When the Ford car was first introduced into England nobody would take the least notice of it—people said that it was made chiefly of string and hoop-wire, and that a buyer would be lucky if it held together for a fortnight! So once more Ford went in for racing—and won. A dealer in Brighton 'had ten Fords driven over the South Downs for two days in a kind

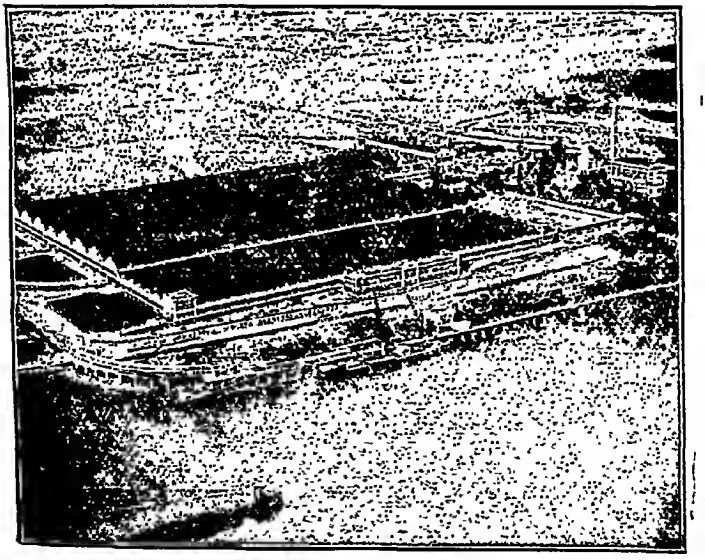
of steeplechase, and every one of them came through'. But the most astonishing thing of all was when a driver actually drove a Ford right up to the top of Ben Nevis, the highest mountain in the British Isles. After that there was no more need for worry: people started to buy Ford cars so fast that it was almost impossible to supply them quickly enough.

In recent years other manufacturers have produced very cheap, good cars, so that fewer Ford cars are seen in Europe today than would have been seen, say, during the Great War. For during the Great War Ford supplied enormous quantities of cars to the English and French armies as well as a huge number of machines for farms (his early ambition, you remember), because he could at that time build them cheaper to run, lighter to move, and more quickly than anybody else.

He was able to do this not merely because he knew how to build motor-cars, but chiefly because he knew how to organize his factories —which is a very special art. Looking after tens of thousands of men and getting from them the best possible work is no easy matter. For example: a man may be working in bad light, or his machine may be cramped against another machine, or he may feel that his job is not the one he is really fitted for. All these things will mean in the end that, unless they



The First Ford Factory



A Ford Factory Today—Dagenham, Essex
Only one of the several immense factories making 'motors for every one'.

are remedied, he cannot do his hardest work, and will grow discontented. A man, if he is a real man, is at his happiest when he is working hard; but to feel that he is being badly treated robs him of all that happiness. Ford believes in treating his work-people very well indeed and in paying them big wages; but in return he expects them to put every ounce of energy into their work; if they do not, they will not stay with him long.

And because he has been able to organize his factories so well, he has been able to fit in a great many men who might otherwise be always out of work—men without legs or without one leg; men without arms or without one arm; blind men; deaf and dumb men; and men with all sorts of ailments. Somewhere or other in this vast factory there is a job that they can do, and be well paid for doing it.

'We have experimented,' he says, 'with bedridden men—men who were able to sit up. We put black oilcloth covers or aprons over the beds and set the men to work screwing nuts on small bolts. . . . The men in the hospital could do it just as well as the men in the shop, and they were able to receive their regular wages. . . . No man had to do the work unless he wanted to. But they all wanted to. It kept time from hanging on their hands. They slept and ate better and recovered more rapidly.'

In Ford's factories men have a great chance of getting on if they show that they have brains and are eager to use them. In short, Ford believes in helping only those who will help themselves: he has had to do it himself all his life. Today he is rich, very rich; but in his young days he was without much money, and he has made his wealth not by charging a big price for a poor car, or by grinding down his work-people. He has made it by doing his utmost for his customers and work-people alike, by trying to be fair all round.

And, of course, by enthusiasm, and by knowing his job—no man who did not know his job has ever got anywhere.

At Work in a Modern Ford Factory
The cars move along on a belt, from workman to workman, each with his special 'part' to add to the building of the car.

XI

How Sir Ronald Ross Conquered an Enemy of Man

The history of Science is a record of attempts made by devoted men and women to wrest from nature secrets which enable us to save life or to develop life more fully day by day. If the seeker after truth succeeds in adding something to the sum total of human knowledge, then sooner or later his work is recognized. If he fails, his work remains unknown to the world, and others carry on the search.

Often the margin that divides success from failure is as narrow as a knife-edge. A few minutes' extra work when the body is already tired beyond endurance and the brain cries 'It is useless' may result in a discovery that will save countless human lives. Sometimes the discovery comes like a flash of lightning. More often, as this volume reveals, it is the reward of infinite patience, of sheer dogged persistence which takes no thought of time or difficulties or sacrifices.

To patience of that order the world owes the greatest medical discovery of the past fifty years —the discovery that malaria, dread scourge of the tropics, is 'carried' by mosquitoes. Apparently simple, yet a discovery that has revolutionized the whole study of tropical medicine, and made inhabitable vast tracts of the earth's surface where formerly men died or were incapacitated in their tens of thousands. None knew how this terrible disease was spread, until the secret was revealed by two British doctors, who will always be honoured as benefactors of the human race.

To solve the problem we have referred to, Sir Ronald Ross toiled for years in India, being encouraged by Sir Patrick Manson in England. A dozen times he nearly abandoned hope of finding the evidence that he sought. His eyesight nearly failed under the strain. He became so weary that when he found his first clue he did not realize that he was on the point of success after years of failure.

The story of how this remarkable man, whose services to humanity have even now not received just reward from those enriched by his work, finally detected the means by which the germs of malaria are spread is one of the most romantic in the whole history of scientific research. Had he failed, millions now living in Asia, Africa, and America would be dead.

Of all tropical diseases the most common is malarial fever. It causes roughly one-third of all the attendances at hospitals in the tropics, and about one-third of the entire population in many hot countries suffers from it every year. Although only about one case in several hundreds proves fatal, yet the disease is so prevalent that the total number of deaths due to it is colossal. It has been officially estimated that in India alone something like 1,300,000 deaths are caused by it in an average year. It has affected Europe as far north as Holland and England. In Greece and around Rome the disease was until recently a curse. Over a vast part of the earth's surface malaria remains a plague which threatens at every turn all who live within the region affected.

For years scientists and doctors sought the secret of how it was spread. Some declared it to be caused by the night air, others that it came from infected water. Both theories were to be disproved.

In demonstrating to the world how malaria was spread, and thus how it could be fought, Manson and Ross defeated the tiny flying insect which until the beginning of the twentieth century was the most dreaded enemy of the world—an enemy before which army, navy, and doctors were powerless.

Sir Patrick Manson was a Scottish doctor, born near Aberdeen, who in 1866 went out to become medical officer at a Chinese hospital in Formosa. There he studied elephantiasis, the strange disease which causes legs and arms, or other parts of the body, to assume monstrous proportions. And there he was first brought into contact with malaria at close quarters.

A theory then generally held was that elephantiasis, a tropical disease like malaria, was caused by the night air of marshes. Manson began his investigations, and came to the conclusion that the presence in human blood of a parasite called the filaria worm probably had some connexion with the disease. But the discovery only raised a greater problem. How did the filaria worm get into the blood? The worm could neither walk nor fly. A possibility was that it was sucked up by something that fed upon human blood, then released again into the bodies of previously uninfected persons.

The evidence pointed to the mosquito, which in biting a person infected with the germs of elephantiasis, and then passing on to uninfected persons, might well spread the disease. To test this theory, Manson examined the blood of some of his native helpers at the hospital. Finding

one who was heavily infected, he induced him to sleep in a room containing mosquitoes and to let them bite him.

The next morning Manson collected the insects, gorged with the blood of the infected boy. He dissected them and examined them under a microscope. They were all infected with live filaria worms. Thus was it discovered that the mosquito was the carrier of the germ which caused elephantiasis.

Manson's discovery set certain men thinking. If the mosquito carried the parasite of one disease from person to person, might it not also spread malaria? A French doctor working in Algeria, named Laveran, definitely suggested that the mosquito might spread malaria. But the medical world in general was in no hurry to give up its theories on the subject. Manson retired from practice in China and went to live in England.

Nothing further was done for some years.

Then in 1894 Major Ronald Ross, of the Indian Medical Service, a doctor who had long been interested in the study of malaria and other tropical diseases, returned to England on leave, and while in London called upon Manson. The hour for the final onslaught had struck. Manson explained his theories to Ross, who resolved, upon his return to India, to begin at once the

experiments which have led to such triumphant results.

Thus began one of the most famous partnerships in the history of research, a partnership between two devoted servants of humanity, one in London and the other in India, who laboured for four years, inspiring and encouraging each other when doubts assailed them.

Back in India, Major Ronald Ross set to work in earnest. He contrived to have mosquitoes suck up blood full of the parasites of malaria. If mosquitoes were actually the carriers of the disease, then the parasites would be found, alive, within their bodies. But although he dissected hundreds of insects, Ross could not find what he was seeking. Actually, he was then trying to infect the wrong type of mosquito, for only one variety, and only the female of that variety, is able to suck up and develop the germs.

Month after month Ross toiled away. Experiment succeeded experiment without success.

Manson still believed that it would be found that human beings contracted malaria from mosquitoes through drinking water infected by the insects after they had sucked up blood containing the germs. Ross disproved this, and found the real solution, but not until he had wasted valuable time in testing Manson's original theory.

In his *Memoirs* Sir Ronald Ross relates how he tried to establish the truth or otherwise of the infected-water theory by taking four mosquitoes which had fed upon a malarial victim and placing them in two bottles with a little water. The bottles were kept in a cool place for a week, at the end of which the mosquitoes were dead. In addition to the bodies of the infected mosquitoes, the bottles contained grubs, showing that the eggs laid by the insects had been hatched.

Now Ross made his test. After removing the bodies of the mosquitoes, but not the grubs, he gave the contents of the bottles to certain persons who volunteered, after a full explanation of the experiment had been made to them, to drink the water. 'I think myself justified in making this experiment,' wrote Ross, 'because of the vast importance a positive result would have and because I have a specific in quinine always at hand.'

The result of the experiment was odd. One man developed an illness which at first seemed like malaria, but when his blood was examined no malarial parasites were found. Two other men who drank the infected water remained quite well.

Further experiments with infected water yielded negative results. In fact, that first case

of intermittent fever, which was a coincidence, was the only case in which any after-effects followed the drinking of water exposed to infected insects.

Eventually Ross abandoned Manson's theory, so far as the means of infection was concerned, and began to search for other means by which the parasites within the mosquito might enter the blood of human beings—the search which was to end in his brilliant discovery.

After many months the strain of the work in a hot climate began to tell upon Ross. He writes of this period in his *Memoirs*:

> At first I toiled comfortably, but as failure followed failure, I became exasperated and worked until I could hardly see my way home late in the afternoons. Well do I remember that dark, hot little office in the hospital at Begumpett, with the necessary gleam of light coming in from under the eaves of the veranda. The screws of my microscope were rusted with sweat from my forehead and hands, and its last remaining eye-piece was cracked.

By now he had begun to suspect that the mosquito he sought was a type which eluded him. One morning a 'mosquito-man', one of the three who collected the insects for him, produced some eggs which hatched into brown mosquitoes with three black bars on their wings. These proved to be mosquitoes of a type which Ross had not worked with before.

They were allowed to bite a malarial patient in the hospital, and later some were dissected. Again no germs of malaria were found. That was on 16th August 1897, in Secunderabad. Ross secured more specimens of the brown mosquito during the next few days.

Thus the story comes to 20th August 1897, the anniversary of which is still called Mosquito Day. The first few mosquitoes placed under the microscope revealed nothing. Then Ross came to one of the last of the batch which had been allowed to feed upon the malaria patient on the 16th. His eyes were already feeling the strain, but carefully, methodically, he searched through the tissues of that tiny winged creature. Again nothing. At last only the stomach of the insect remained to be examined. That meant half an hour's work, and already he was tired out. Moreover, he had examined the stomachs of thousands of mosquitoes without finding any trace of the germ.

Tired as he was, he began to work again, but a kindly fate must have watched over Ross that day. What followed may best be told in his own words:

> I had scarcely commenced the search again when I saw a clear and almost perfectly circular outline before me. The outline was much too sharp, the cell too small, to be an ordinary stomach-cell of a mosquito.

I looked a little further. Here was another and another exactly similar cell. I now focused the lens carefully on one of these, and found that it contained small grains of some black substances, exactly like the colour of the parasites of malaria. I counted altogether twelve of these cells in the insect, but was so tired out with the work and had so often been disappointed before that I did not at the moment recognize the value of the observation. I went home and slept for nearly an hour. On waking, my first thought was that the problem was solved, and so it was.

Ross had discovered that the germs of malaria were sucked by certain mosquitoes from the body of an infected human being, and developed in the stomach-tissue of the insect. He had made one of the greatest medical discoveries, saved millions of lives, and yet he did not appreciate what it all meant until he had slept! That incident reveals how utterly weary he was, in mind and body, at the end of months of failure.

The next day Ross dissected the last survivor of the same batch of mosquitoes. Within its stomach he found similar cells—only larger! That was conclusive. The cells were parasites, and they not only lived, but grew within the mosquito. The discovery was really two discoveries, and each was of vital importance. As Ross wrote afterward:

We had to discover two unknown quantities simultaneously—the kind of mosquito which carries the

parasite, and the form and position of the parasite within it. By an extremely lucky observation I had now discovered both the unknown quantities at the same moment. The mosquito was the *Anopheles*, and the parasite lives in or on its gastric wall and can be recognized at once by the characteristic colour. All the work on the subject which has been done since then by me and others during the last thirty years has been mere child's play which anyone could do after the clue was once obtained.

In his great joy at the prospects opened up by the discovery Ross composed these verses to commemorate the day:

This day relenting God
Hath placed within my hand
A wondrous thing; and God
Be praised. At His command,

Seeking His secret deeds
With tears and toiling breath,
I find thy cunning seeds,
O million-murdering Death!

I know this little thing
A myriad men will save.
O Death, where is thy sting?
Thy victory, O Grave?

The key had been found, but much more remained to be done. Ross had studied the germs five days after they entered the mosquito. But what happened afterward? How did the

mosquitoes infect human beings, and possibly each other? These questions had to be answered in order to place in the hands of doctors a means of fighting the scourge.

Unfortunately, at this point in his investigations Ross was ordered to report to headquarters in Bombay for military duty, and for some months no further progress was made. Ross wrote fully to Manson, however, sending him specimens of the malaria-bearing mosquito.

Then friends in London interceded with the India Office on behalf of Ross, and in January 1898 he was placed on special duty for six months to enable him to take up again his malaria research work, now at so promising a stage.

He went to Calcutta, where human malaria is scarce, and there he settled down to work out with bird malaria the complete cycle of infection.

By March Ross had found the species of mosquito capable of carrying the malaria parasite of birds, and within a few more weeks he had traced step by step the parasite's development from the moment when it entered the mosquito until the moment it was found in the body of the infected bird. In the course of these experiments Ross gave malaria to twenty-three out of twenty-eight captive birds, none of which

could have been infected by any means save the mosquitoes which were placed under the nets of their cages.

At last Ross knew just how malarial fever was spread; the sequence of events had been explored from beginning to end. On 21st March 1898, Ross wrote home to Manson:

> My wish is that you were here to share with me the pleasure which I have experienced yesterday and today in seeing your theory verified step by step. Such pleasure comes to but few men, I fancy, though you must have felt it in regard to filaria [elephantiasis]. This, of course, means the solution of the malaria problem.

When the news of this further success reached London the British Medical Association was about to hold its annual meeting at Edinburgh. It was at this meeting, in July 1898, that Sir Patrick Manson announced to the medical world the discoveries which Ross had made, and he showed for the first time the slides he had received from India. The meeting 'unanimously passed a resolution sending Major Ross the Members' congratulations on a great and epoch-making discovery'.

Ross had won, but still the last link in the chain of evidence had to be forged. Ross had carried out his experiments on birds. It was very probable that human malaria followed the

same cycle. But there was as yet no absolute certainty, and could not be until the tests had been carried a step farther.

In the malarial region of Italy others seeking proof had infected human beings with malaria by means of mosquitoes, but there was also the night marsh air, the hot climate, and other possible sources of general infection. Manson decided to demonstrate the value of Ross's discovery once and for all by bringing mosquitoes infected with the malarial parasite to London, where there was no malarial fever at all, and there infecting human beings by means of the insects.

Several small cages covered with fine netting were constructed, and in these the infected mosquitoes were hurried across Europe to London. There they were allowed to bite two men who had volunteered to contract malaria in order that the last link in the chain of evidence might be forged. The first of these men was Manson's son, P. Thornburn Manson. He was exposed to the insects on 29th August 1900, and again two days later. Anxiously Manson and his colleagues waited for the period of incubation to expire. The proof was forthcoming. Young Manson began to have fever on 13th September, and on the 17th the parasites of the disease were found in his blood.

The second volunteer, Warren, was exposed later. He too contracted malaria. This experiment helped to confirm the fact for the whole medical world. As Ross has written, 'a more brilliant verification of them could not have been devised'.

The process by which the parasites of the disease are first sucked into the body of the mosquito, and later injected into the blood of another person, is one of the most amazing things ever discovered about the insect world.

Three or four days before the female mosquito lays her eggs she settles upon a human being and gorges herself with blood. If the person she happens to bite is infected with malaria, the insect sucks up into her stomach the parasites of the disease. These parasites do not die, but are fertilized and multiply while within the mosquito. The malaria germ then undergoes a change, after which it finds its way down the walls of the insect's stomach and forms a cyst. In this cyst thousands of little pointed bodies develop, until finally the cyst bursts and these bodies find their way into the salivary glands of the insect. The germs are then ready to leave the mosquito's body, and the next time the mosquito pierces the human skin to suck blood they enter the puncture, and a few

days later there is another victim of malarial fever.

All that is probably a little difficult to follow, but its being so is a further tribute to the endless patience of the man who tracked down this amazing secret of nature for the first time, by dissecting thousands of tiny insects, and who, despite many failures, thus pieced together that complete picture.

There were many ready to scoff. Even after Ross had infected birds by exposing them to malaria-carrying mosquitoes there were many who declared that he and others had 'mosquitoes on the brain'.

Happily Ross was content to pursue his investigations to the end, undeterred by criticism and unspoiled by praise. He believed he was on the right road. That was enough. To him is the glory of a great victory over death and disease.

Ross's discovery brought him honours, but not wealth. Like many others who have devoted their lives to research, Ross was always a poor man. For his work he was awarded in 1902 one of the greatest distinctions of its kind in the world—the Nobel Prize for Medicine. There exists in Putney, in England, an Institute of Tropical Diseases named after him, and of which he was Director-in-Chief until his death

in September 1932. The medical societies of the world have paid tribute to his great work in conquering malaria.

That work still marches on. The new chapter in the battle with tropical diseases which Ross and Manson opened is not yet finished. It may be found that other deadly diseases are spread by the same winged insects. While Ross's discoveries were still recent, American scientists turned to them in the hope of discovering the cause of yellow fever, which had broken out among American troops at Havana in 1900. In mosquito-proof cages men were exposed to the soiled bedding and clothes of yellow-fever victims. They remained free of the disease. Then volunteers were called for, and a number of brave young American soldiers, knowing the risk they ran, volunteered to be bitten by mosquitoes which had fed on the blood of those already sick. All who were bitten developed the disease, and before the end of December 1900 it had been proved conclusively that just as malaria is spread by mosquitoes, so is the even more deadly yellow fever. The discovery was made by Dr. Walter Reed and the other Americans who fought the epidemic, but some of the honour must also be awarded to Sir Ronald Ross and Sir Patrick Manson, whose discoveries had already pointed the way.

Sir Ronald Ross

[Fox Photos.

Sitting in the barracks at Cuba, amongst those afflicted with the disease, Dr. Reed wrote to his wife at 11.50 p.m. on 31st December 1900:

> Only ten minutes of the old century remain. Here have I been sitting, reading that most wonderful book, *La Roche on Yellow Fever*, written in 1853. Forty-seven years later it has been permitted to me and my assistants to lift the impenetrable veil that has surrounded the causation of this most wonderful, dreadful pest of humanity and to put it on a rational and scientific basis. The prayer that has been mine for twenty years, that I might be permitted in some way or at some time to do something to relieve human suffering, has been granted.

Outstanding as Reed's achievement was, Ross's discovery deserves even greater praise. To it may be traced nearly all the progress made in fighting the malignant fevers of the tropics. What Ross's discovery has meant in those regions is made clear in a letter written to him by General Gorgas, of Panama Canal fame.

The letter is dated 23rd March 1914, and in it General Gorgas says:

> Before leaving England I wish to express to you the debt of gratitude we all feel to you for the great work you have done in the field of Tropical Medicine. As you are aware, malaria was the great disease that incapacitated the working forces at Panama before our day. If we had known no more about the sanitation of malaria than the French did, I do not think we

could have done any better than they did. Your discovery that the mosquito transferred the malaria parasite from man to man has enabled us at Panama to hold in check this disease, and to eradicate it entirely from most points on the Isthmus where our forces are engaged.

It seems to me not extreme, therefore, to say that it was your discovery of this fact that has enabled us to build the Canal at the Isthmus of Panama.

A fine tribute, and one that was richly deserved.

When Ross came to India as a young man he found every one, even the most brilliant doctors, struggling in vain with a disease which attacked millions every year. They could control its attacks with quinine, but they could not prevent them, and they did not even know where to look for the enemy. In the course of four years Ross both discovered the enemy and showed how it could be conquered.

Those yet unborn, wrestling with other secrets of life and death, will know moments when the struggle seems hopeless. In those moments perhaps they will remember the story of Sir Ronald Ross, and find in it their inspiration.

XII

The Adventurers of Tomorrow

We have pictured the adventurers of the Past; brave, determined persons of bright fancy and courageous action; people who saw and desired and achieved more than their contemporaries: leaders of their own or of succeeding generations. We have seen them sailing the world's uncharted seas; penetrating into its unknown regions; seeking out the hidden treasures of truth and science. We realize that our world of today is rich and habitable because of their labours. The knowledge that we get so easily from books they gained with suffering and by great endurance, often at the peril, and sometimes at the cost, of their lives.

The newspapers, the cinema, and the 'wireless' remind us ever and again of the adventurers of Today. Just as bravely, with just as much determination as the adventurers of the Past, they are opening up to us more of the wonders and resources of our earth. Out of the

soil, out of the ether which wraps the earth closer than its covering of air, these seekers are bringing great secrets to our knowledge. They are charting, not roadways nor seaways, but airways around the globe. They are pushing their way into the mazes of tropical forests and bringing out valuable products for the world's markets. They are getting good grain from soil that has never before been broken by the plough. We know the names of a few of the most famous of them; but there are many more whom neither we nor history will ever know.

The adventurers of the Future sit beside us in school, and play with us in the playground. Some of them are keen members of the football and hockey teams and swimming clubs; some care not a rap for sport. Some carry off honours and prizes; some would rather find a rare blossom or get a good snapshot of a bird emerging from its egg, than win a gold medal or head the examination lists. As yet we cannot distinguish them certainly, and can only guess what great things they may achieve by and by. But the great adventure, Life, is before them, and each will presently start upon one of the more or less well-defined paths which were opened into the forest of the Unknown by the pioneers of human knowledge. When the path ends the adventurers of the Future will push

on, for that is where their journey and work begin.

Perhaps you will say that very little of the world's surface remains unexplored: that if we except the greatest mountain heights, the frozen and uninhabitable polar regions, the equatorial forests and the deserts, the land is already known, mapped, and very largely cultivated.

That is true. But it is not cultivated to the best advantage. It is not everywhere producing things of use and beauty, to the joy of the cultivators and for the universal benefit of the world's family. The adventurers of Tomorrow will discover ways of watering deserts, of improving poor soil, of protecting crops from pests, of associating groups of plants so that they shall aid one another's growth instead of, as at present, thriving at one another's expense. They will learn of the Sun and the Winds, and find methods of sheltering exposed crops from harsh weather. And they will make it possible to convey the world's wealth of food, textiles, wood, and metals, so speedily and with such freedom from country to country, that famine, the scourge of India, starvation, the recent fate of Russia, and even shortage of materials used in industry, shall be no more the lot of any part of mankind.

There are other regions awaiting discovery. As in the dreams of Columbus there lifted, away over the waters of the Atlantic, a fair and sunny land, so in the vision of many men and women of today there rises the picture of the New World of Health. Towards that land we have sailed but a little way. Some diseases, more devastating than earthquakes, we have indeed faced and overcome; plague, cholera, small-pox have almost been brought under control. Yet our hospitals are full of patients suffering from a great variety of less infectious, but nevertheless painful and odious complaints, and the doctor is a very familiar visitor in our homes. Many of the adventurers of the future will spend their lives in hunting down, isolating, and destroying the germs of disease. Life will be healthier, happier, and more vigorous than it is today, because of their work.

And there is the New World of Peace. Today it is just a dream in the minds of a few far-sighted people. These prophets firmly believe that a time will come when the children of mankind shall discover ways of settling all their differences without going to war; when war will seem as absurd as the out of date and now illegal 'duel' between two gentlemen; when armaments and warships will be as obsolete as city walls. But the majority of the men and

women of today cannot believe this possible. They deny this Peace World exactly as the Genoese and Spaniards of Columbus's time denied the possibility of a Round World. It remains for the adventurers of Tomorrow to make this dream a reality.